THE FOUNDRY

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Molding a 30-Inch Check Valve in Loam.

BY ARCH. LANDON.

This valve was cast in the foundry of the Michigan Brass and Iron Works, Detroit, Mich., for a St. Louis firm. The method employed in the molding may be of interest to readers of THE FOUNDRY.

Sketch No. 1 shows the complete valve, without the flaps, as they are not material to the method of molding; sketch No. 2 is the outside view of flange, and No. 3 shows the inside of flange and the ribbed pockets which made the molding especially difficult. Most of the pockets were 9 inches deep, 4 inches wide and 18 inches long.

The operations in molding were as follows: After setting the sweep-board in proper position, the bearing was built up and swept as at B B in No. 4; when this had become stiff enough to work upon, two angle boards were set up like No. 6, one on each side of bearing, parallel to each other, with centers fixed from the spindle, and so adjusted that the bed, when swept, would start at its lower edge from the original bearing. The mold was built up to these boards, leaving one inch for loam, which, when added, was struck to the upper edges of boards and left to stiffen. The diaphragm flange a a was then set by the spindle as shown in No. 4 at a a, the external pockets were filled up with loam, chips of brick and spike nails (as the core had to rest on them when the mold was finished), and the joint was made. The ribs on top of the diaphragm flange were then placed, the sweep still remaining as originally set. A bed of loam was then put into the internal pockets, and an arbor was made to fit each pocket between the ribs, leaving about ¾ inch clearance all round for shrinkage. Each arbor was united by staples, as shown in No. 5 at c c, thus forming the series of arbors into a complete basket. Two half-inch nuts were cast in each arbor, and bolts were screwed into these, passing up through the pockets, and being connected with the plate above. The arbors being set in position, with the bolts inserted, the pockets were filled with loam and loam bricks, with a wedge in the center of each pocket, which latter was drawn after the filling was completed, and the space was filled with fine cinders; then a bed of loam was put over all, with a layer of straw above that to facilitate venting. The plate E, sketch No. 5, was then placed on top. This plate was cast with holes for all bolts to be used in it, round holes at the edge and slotted holes for the arbor bolts and to permit of free escape of gas. The plate was bedded solidly on the staples and all bolts secured, and above this the core was built up to the top, and plate F affixed, four hook-bolts engaging in staples in plate E, passing up through holes in plate F, secured the whole core firmly together from the extreme top to bottom of pockets. The stripper piece on sweep G was now removed, and thickness swept on with fine molding sand, after which the sweep was removed.

The outer flange, H, was now placed in position, beginning at I on the bearing made by the first sweeping, and the top of flange made to correspond with the plane of diaphragm, the sides at center line being gauged by measurement from top of core. The sand for thickness under the flange was then removed, and the bearing proper was then built up, and joint made at K K with a 6-inch bearing around the base for the check plate to rest upon, the outer edge of flange H serving for a guide. The check plate being placed in position, the flange H was oiled on all exposed places, the other part of the joint being washed with wood ashes for a parting.

The outside was then built up the same as when a solid pattern is used, and the brick work was strengthened by iron hoops, to make it secure for handling.

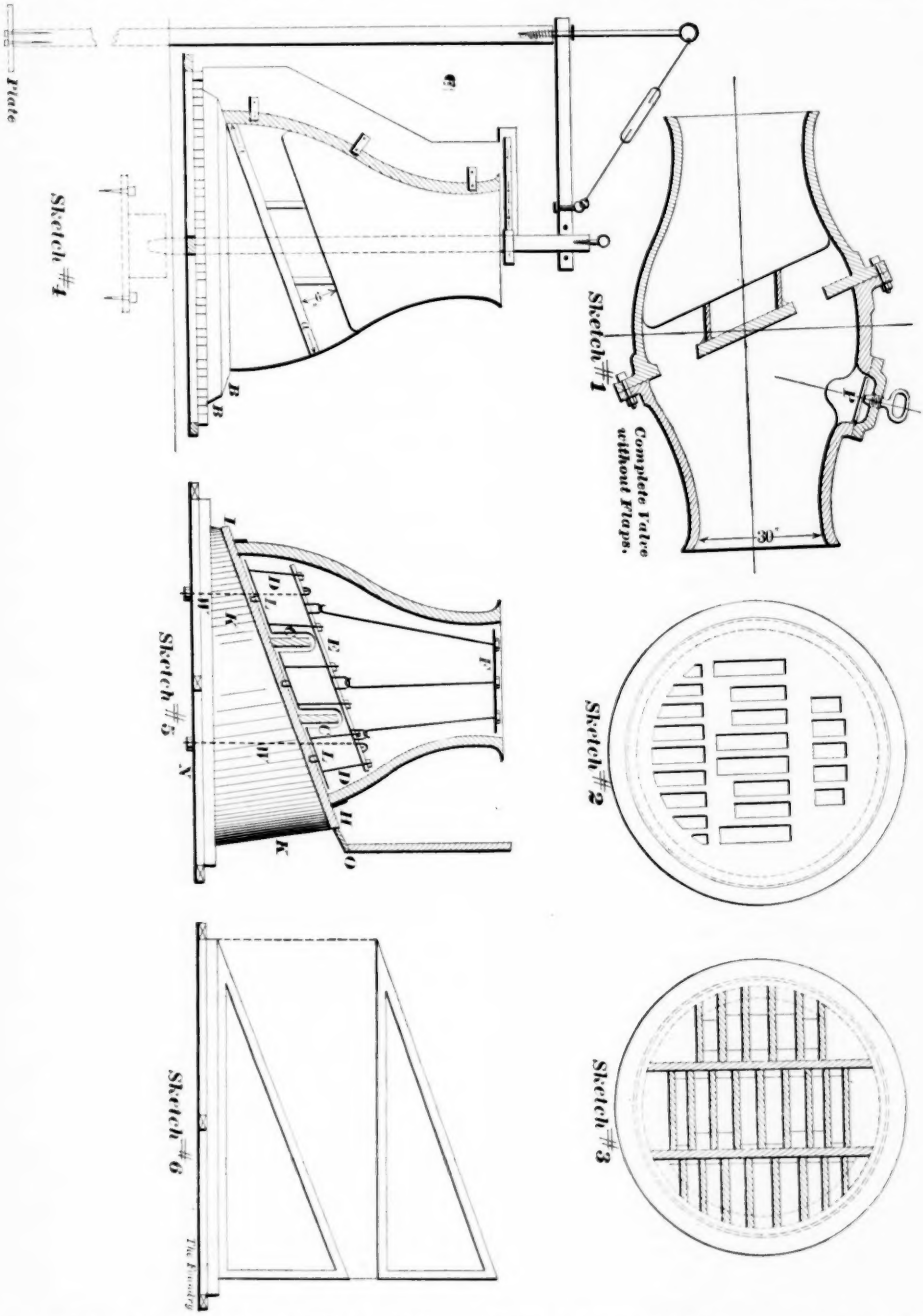
The outside flange H was lifted away with the check, the thickness removed and everything made ready.

The core was now parted from the diaphragm flange a a, taking the ribs that formed the pockets with it, and these were

withdrawn. the core finished and blackwashed, and dried enough to give it sufficient strength to support itself on a bed of brick and coke built up to the angle of the core and faced with a layer of finely riddled dry sand, before removing it from the crane.

The core was now lowered upon the bed, which had been built on the carriage. The rest of the mold was finished in the usual way, and all was put in the oven and thoroughly dried.

The pocket arbors were provided with projections which, when the core was set, fitted into corresponding depressions in the bottom part of mold, as shown at L L, Fig. 5, which guided the core to exact position.



Two hook-bolts were passed from lifting plate E straight down through plate N and bolted securely to prevent possible movement of core while casting. The cheek was then closed on to guides on both bottom and cheek plates at I I I and I I I I, not shown in cut.

The pit was then rammed up and the mold secured by binders and hook-bolts running through slings in bottom plate. It was poured through two gates, 3½ in. x ¾ in. in flange at O, Fig. 5, the two down-gates being 2 in. square, extending from pouring basin to joint of mold. Four risers were set on top. The cast was very successful; the diaphragm part weighed 6,100 pounds. The plain half was molded in the same way, except that the core was built up solid from foundation plate, there being no internal flange. This piece weighed 4,200 pounds.

Feeding.

(Or the Compressing of Metals.)

BY WM. ROXBROUGH.

PART II.

(4th.) It is a disputed point amongst molders as to whether cores in molds have any influence in the matter of feeding. I can well remember in my early apprenticeship days immediately after a mold was cast hearing men shouting "Keep out that feeder; there is no need for it; the core will do all that is required," and not until I had gained considerable experience as a molder did I ever trouble to find out as to whether this theory was true or false, as, like many others, I just fell in line and took the thing as a matter of course. This theory is simply one of many foundry legends and is just as ridiculous as the idea common amongst molders that a core placed in a mold, if once the fluid metal drowns or enshrouds it, will remain in its place. The cause of this belief is probably the swelling action which takes place in the riser basins immediately after a mold containing many cores is cast. This swelling is caused by expansion of the cores, which must necessarily follow through these being enveloped in fluid metal. It is after this action has fully spent itself that any good will result from feeding, but usually the molder becomes uneasy and chokes the gate, thus defeating all attempts at feeding the casting. What should be done is to keep the gate open until all expansion of cores is past, and when this point is reached, contraction immediately sets to work which demands the assiduous attention of the molder to work his rod up and down in order to keep the gate open and admit whatever metal the casting is craving for during the process of solidification. The importance of this cannot be too much impressed upon molders, as it is generally at this stage that the damage is done through the molder's hastily retiring; therefore it is the foreman's duty at all hazards to see that whoever may be feeding shall have at hand a supply of the hottest metal procurable. No doubt cores are a very serviceable adjunct in the way of proportioning, and I have many times put in cores which were the means of improving matters in this respect, such cores being termed "lightening cores," on account of their being used to proportion the metal, thus lightening and removing all danger of sponginess.

(5th.) Temperature. Every metal has its own peculiarity in the matter of temperature, just the same as every mold has its individuality in respect of casting, and unless a molder has a masterly grasp of these two points his knowledge of casting is very superficial. The tendency in these days is to make matters pertaining to foundry practice a great deal worse for molders than was the case twenty-five years ago. Everywhere are seen castings with attachments of various forms, and a variety of thicknesses, which give a great deal of trouble on account of these being in many cases lighter than the general body, and were one to cast at a temperature suitable for the general thickness of such castings, the lighter parts referred to could not be run up, and the result could only be a bad casting. The case may be modified by using a small ladle containing metal of the requisite heat. Scores of cases could be cited to prove this, but perhaps the one example, viz., that of pillow block covers, will suffice. The common practice in casting these covers nowadays is to cast the oil cup on the cover; the thickness I have never seen greater than from ½ in. to ¾ in., even supposing the cover casting having an average metal of from 8 in. to 10 in. and weighing about one ton. The contrast here must be very striking, as the temperature to cast such a mold should not exceed the dull cherry red, and without the use of the small ladle containing metal of a milky white color, which should at the proper time be put in by the aid of a small riser basin with sufficient gates attached to the cup, all

chance of a good cup on the casting would be an impossibility.

As will be seen from Fig. 5, the oil cup is cast on the exact spot where the feeding gate ought to be, as all feeding gates should be on the highest part of the casting, but being unable to place the gate as mentioned, the next best move is to fix for two gates, as shown in Fig. 5. These two gates, on account of their position, can at best, only give imperfect solidity, as in such a casting one gate is capable of producing better results when placed on the highest part of the casting. In feeding, while one can do much in assisting to keep down cavities when the rod is applied at the proper place, still the efforts for good in this direction are greatly minimized when location of feeding gates becomes a matter of necessity but not of choice. When casting a dry sand mold, it is of much importance to know that the mold is thoroughly dry. If there be doubts about this, by all means cast at as low a tempera-

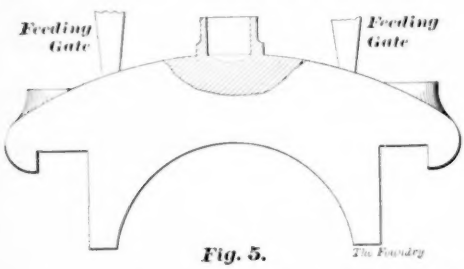


Fig. 5.

ture as possible. The meaning of this must be obvious to practical men, as, by doing so, the danger from "dumb scabbing" is greatly lessened, the lower temperature of casting giving less chance for steam to generate and create scabbing. The conditions with regard to temperature as laid down here are equally good when applied to loam casting. In green sand work the best results are always obtained by casting at as low a temperature as circumstances will permit. This may appear to be somewhat summarized, but there is really no fixed law to guide, other than that of experience and close observation.

(6th.) Metal. As this article has been principally taken up with iron foundry practice, the reference to the finer metal being more to illustrate the various branches under consideration, therefore whatever convictions may be formed by those interested must be viewed from an iron molder's standpoint. Skill in adapting the various brands of pig and scrap in mixing, can only be acquired by those who are in a position to command, and, just as doctors differ in physical treatment, so do molders at times differ very much in the mixing of metals. Hence there is really no fixed rule of mixing. It has frequently happened in my experience that a judicious mixture of a cheap iron which carried with it a more fusible matter, such as phosphorous or graphite when cast at the right temperature, gave greater satisfaction than a costlier article commonly specified. Every brand seems to me to have a nature peculiar to itself, and not until one gets to know this, and how to treat it, can he expect to succeed. Perhaps this may be viewed as drawing the line too neatly, but to those who have given the subject of the physical properties of cast iron any study at all, it will likely confirm previous convictions. Probably nothing in nature is more susceptible to chemical or mechanical action than cast iron. It is within the reach of any molder to prove this; all he has to do is to make an open sand mold, say 3 feet by one foot, by 1 inch thick. The first foot of the bottom of this mold, say, is a common iron plate, next in order one foot of dry sand, and last a foot of green sand. Make up a small running head from either end, and when cast and cooled break those parts through in their separate divisions, and you will find by ocular demonstration the truth of my statement. Each will have quite a distinct appearance in fracture, and I doubt not a very decided difference in chemical analysis.

(7th.) Dirty metal. This phrase is an everyday expression among mechanics, in seeking to explain defective parts as they reveal themselves in the usual routine of work in a machine shop. Of course, all defective parts do show a dirtiness, but this is seldom attributable to dirt in the metal, unless it be in the form of slag or dirt accumulated from the mold at time of casting. I regard all pig metal smelted as a homogeneous article. No doubt there are metals which have a preponderance of objectionable constituents, such as graphite, phosphorus and silicon, and other elements may be present which reduce tensile quality, but these can in no way be regarded as dirt, as they are all in their way essentials to assist fusion and fluidity, and to eliminate them would make the best of pig metal altogether unsuitable for the finer class of castings. It is an acknowledged fact that brands whose natures are as mentioned here are becoming

more acceptable for many classes of work, and especially those castings which are hydraulically tested. Brands which are high in fusible elements are low in tensile quality, and are consequently less susceptible to oxidation, which is the best guarantee against cold shut, are more uniform in fracture and have less tendency to create cavities in disproportionate parts. But where a dragging of the crystals through ineffectual feeding occurs and these showing sponginess under hydraulic pressure, there is nothing to dread; it only requires a little time to oxidize and encourage the growth of corrosion, which will eventually and thoroughly densify the spongy parts. The importance of adapting the metal proper for the various classes of castings passing through the hands of those in charge of a foundry cannot be overestimated. That which would suit and cast a first-class cylinder, would be utterly unfit to cast an ordinary water pipe. The cylinder would require a metal hard, and comparatively free from fusible matter, while in the pipe there must be a preponderance of the fusible element, which always gives increased fluidity when cast at the right temperature. And now I have written at length; yet, notwithstanding all that has been written, it is far from exhausting in detail the many points relating to this question. As I have stated, nothing but what has occurred to me as a molder of over 30 years' practice, I shall be delighted if my article be the means of awakening others to do likewise.

(Concluded.)

Mending Holes in Retorts.

BY R. D. MOORE.

The writer once had a very interesting experience in patching castings by "melting on."

The castings treated were retorts used for vaporizing sulphur in whisky distilling; an experiment, I presume, I should have hesitated about promising success, but they were dropped at the foundry door without my knowledge or consent, so I put on a studying cap for two days.

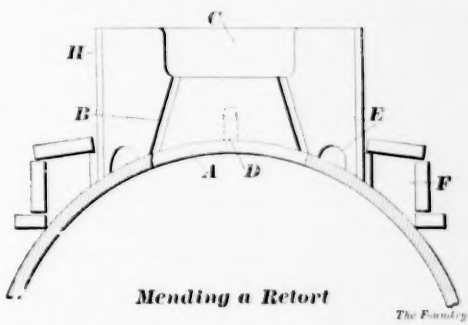
They were shaped much like an ale bottle, about 3 feet diameter in the chamber, the whole length 8 feet, with 1¾ inches thickness of metal. Careless firing or want of a guard wall, had melted holes near the bottom about 16 inches diameter.

The casting was laid on its side in a shallow pit, and standing about 18 inches above the floor for a convenient position, with the hole upward. The chamber under the hole was filled with brick bats, nearly full, some hay spread over them and sand rammed and a parting made to form the "core."

A "thickness" of sand was then rammed and parting made to form the "pattern."

An iron cope, H, made to fit the casting and overlapping the hole about 5 inches all around, was then rammed, and chisel marks made on the casting at the corners of the cope to close by. The accompanying rough sketch shows a section through the center of patched hole A and most of the other complicated rig necessary to success.

A row of pouring gates, B, ⅝ inch diameter set 3 inches apart following all around the border of the hole and leaning inward to throw the hot metal forcibly outward



Mending a Retort

The Foundry

against the edge of casting as an assistant in melting on rapidly.

A pouring basin, C, was made at the top of the cope to connect all the pouring gates, made level at the bottom to insure equal discharge.

Another 1¾ inch gate, D, set on patch, near the end, running up 4 inches and then out horizontally through a hole provided in the end of the cope, served as a discharge for the surplus metal.

On the opposite end to the discharge another 1½ inch pouring gate was set on the 5 inch blank space between the flask and patch mold, and when the cope was turned over a gutter, E, 3 inches wide was made all around the blank spaces about an inch from the mold and connected with a 1-inch discharge gate at the other end.

The object of this channel was to assist in heating the edge of the casting immediately before commencing the "melting on" by pouring about 400 pounds of iron through it.

Nothing less than a red heat on the casting, extending several inches from the hole, and a high red at the edge, would give any promise of success in the union of the old and new metals.

To secure a good general heating a rough fire brick stove cylinder, 16 inches diameter by 24 inches deep, was built below ground and close to the butt end of retort.

Both parts of the mold being now thoroughly dried, the cope, after being moistened on the parting to make it fit close to casting, was closed to its place and a flue of bricks and mud, F, was carried from the stove pipe all around the cope, meeting on the opposite side with an uptake.

A 6-inch flanged pipe was erected over the flue on mud packing as a chimney to urge the draft.

It being desirable to keep the heat as near the patch as possible, a ½-inch wall of mud was laid against the iron cope, shaved off level and dried, as an inside support for the top bricks of flue (see sketch). The casting, of course, formed the bottom of flue and was made clean to receive heat rapidly.

About six hours before melting time a coke fire was started in the stove and increased to strong fire with such effects that at pouring time a decided reddening of the casting at the edges of the hole was visible on looking down the dark pouring gates.

The first 400 pounds of metal melted was poured slowly through the heating channel, F, and the discharge hole stopped to retain the last metal.

After a few minutes' delay the edges of the casting showed a decided increase of redness, when the real process of "melting on" was commenced. Ten 150 pounds shank ladles were manned, 4 to catch and pour into the mold and 6 to catch at the discharge hole of the mold and pour the plain work about the floor that had been selected for that iron.

The metal as it came from the cupola was quite hot and the passage through the mold robbed it of so little heat that it was all utilized in other work.

Sixteen ladles, containing over 100 pounds each, were used, and the discharge stopped in time to secure full gates.

Three very similar patches were treated in this manner and were, to all appearances, well united.

To show the difficulty in mending a casting of any considerable weight without heating, my experiments in renewing broken cast pins in cast flasks, about the size of a man's forefinger, show that it requires over 150 pounds of hot iron in a hot ladle to make the stump hold to the new pin.

The mold was dried and hard, allowing the iron to fall over a foot exactly against the stump.

Brass-Melting Furnaces.

Their Design, Construction and Operation.

By C. VICKERS.

PART I.

During recent years, considerable structural changes have taken place in brass furnaces. The oldtime square melting holes, set in massive brick work, are fast becoming a thing of the past: such a design is not only unnecessary, but expensive to build. The modern brass furnace consists of a circular iron shell, lined with a single layer of firebrick. It is needless to back up the firebrick with layers of common brick, as it in nowise adds to the life of either lining or shell. When the lining is burnt out it must be renewed, otherwise there is a waste of fuel and as to the shell, if the air is allowed to freely circulate around it, there is no danger of its ever burning through.

Fig. 1 is a section of a natural draught furnace with flue, B, which is shown large enough to accommodate a whole battery of furnaces, which stand in rows on either side of the flue. The furnaces are supported on trestles, high enough to admit of the easy withdrawal of the ashes. These trestles may be constructed of old rails, resting on suitable brick supports as at A.A., Fig. 1. C. shows the ashpit, made roomy enough to allow the men to work freely in removing the ashes, adjusting the grate bars, etc. This construction admits of the use of a wheelbarrow, so that the ashes can be wheeled out, by means of an inclined plane leading outside of the shop. Suppose we wish to construct a battery of such furnaces, we first make an excavation large enough to contain the number of furnaces we contemplate erecting, then build the flue, and erect the trestles as shown. The material needed for each furnace is as follows: An iron shell (No. 16 iron will do), two cast iron plates, a rectangular cast iron flue, and the firebrick; sometimes these latter are circular in form, and conform to the arc of the

casing. This is unnecessary, however, as wedge-shaped arch bricks will do just as well. The plates may be cast in open sand, they are square, and should be wide enough to abut one against the other, to make a nice level top to the furnaces and allow air space of two inches between the casings, in order to prevent their burning through. Fig. 2 is a sketch of plates. A shows the bottom plate, and B the top. It will be noticed that the bottom plate is cast solid, and has two parallel ribs 2½ inches in depth cast on one side. These ribs hold the plate off the trestle so as to allow space for the grate bars to pass beneath, and rest upon the rails. The top plate may also be solid, but is here shown cast in halves, and banded together by wrought iron strips; this prevents cracking. In setting up the furnaces, we first place the bottom plate in position on the trestle, then adjust the sheli centrally thereon. The diameter of the shell is about nine inches greater than the circular hole in the plate; this gives a ledge of 4½ inches in width for the support of the lining. This ledge is covered with a layer of thick fire clay and the bricks, which we will suppose are slightly arch, are bedded thereon ends down. The whole circle is completed dry. The joints in front are then plastered up with thick fire clay—any wide interstices between the bricks and the shell are filled with broken brick, and the whole is then filled up by pouring in fire clay mixed to the consistency of batter. The second circle of bricks is then placed on this, and filled up with batter as before, and so on until the lining is completed. The cast iron flue is placed in position and bricked in at the proper stage, making the connection to the main flue. An even layer of thick fire clay is spread on the top layer of bricks and the top plate

Fig. 1.

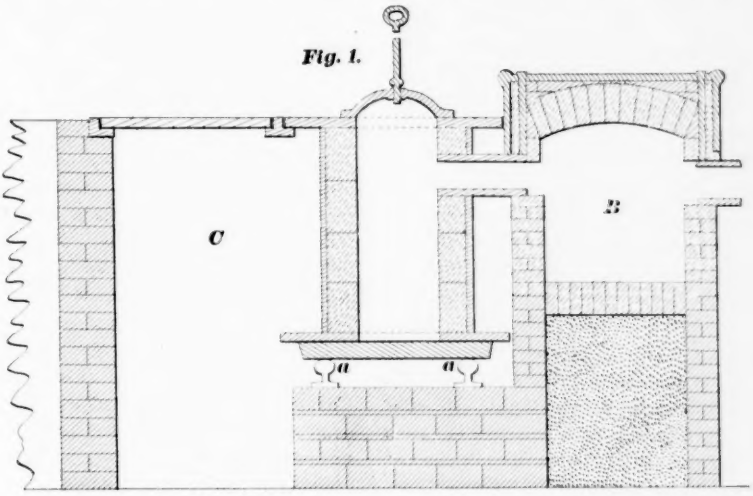
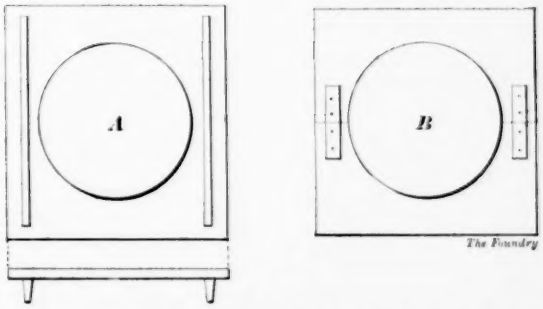


Fig. 2.



bedded thereon. If desired, holes can be cast in four corners of the top and bottom plates, through which are passed long bolts, thus preventing shifting of the top plate and firmly binding the whole structure together. A finished appearance is given to the furnace by circularly sweeping over the inside with a soft brush dipped in water.

The dimensions of the furnaces must be proportionate to the size of the crucibles they are intended to take. Generally the diameter of the furnace exceeds that of the crucible by about six inches; this gives space for three inches of fire around the same. A bed of fire eight inches in depth will be enough to allow the top of the crucible to come an inch or so below the bottom of the flue, when first charged. As the fire burns away the crucible will sink and when coke is the fuel used, will generally have to be raised during the operation of melting. These furnaces are simple, cheaply constructed and yet thoroughly efficient.

As before mentioned, the sketch shows the flue of area large enough to accommodate a considerable number of furnaces. In case one or two furnaces only are required, such a flue is unnecessary, as we can connect the furnace directly into the stack.

In all cases the area of the main flue should exceed the combined areas of all the furnace flues connecting, in order to avoid friction and obtain a good draught. The grate bars are loose and may be of either wrought or cast iron: wrought iron has the advantage of being almost indestructible. But cast iron is what I prefer, because we can cast them with lugs on either side, so that the bars are spaced evenly when in position, and consequently cannot shift. Straight bars have a tendency to bunch together here and there, leaving holes through which the fuel drops, thus leaving the bottom of the pot bare, and chilling the metal. Some founders prefer to have the grates cast in one piece, hinged at the rear of the furnace and propped in their working position, so that when the day's run is over the props can be jerked away, letting the bottom drop, thus leaving the furnace ready for slagging out. This is a convenience, but we cannot stand our furnaces on a common trestle; each furnace must stand on an independent base, and the whole of the ashpit where the furnaces stand, must have a good foundation, otherwise as the furnaces settle they will get out of the perpendicular, and some will cant sideways, and others forward, which to say the least looks unsightly. I mention this because I have seen it occur.

Speaking personally, I prefer the trestle, as there is nothing to impede the draught and there is lots of room for the ashes, and, given a good foundation under each of the brick supports there is no danger of the furnaces canting, and when care is taken to have the shells of equal height, the tops of the furnaces are uniformally level. In the sketch, the covers are shown of a dome shape, like an inverted basin, with a 1½-inch hole through the centre, into which a loose handle is inserted to remove the cover. This dome shape is better than the flat cover, because it does not warp so much, but is liable to crack in time. To overcome this built-up covers have been designed; these are sometimes formed of diminishing cast iron rings bolted on top of each other, the whole covered with a flat plate.

It is surprising how quickly one of these furnaces can be put together. The writer was at one time employed in a ..... foundry, and on one occasion, business being dull, the opportunity was seized to thoroughly overhaul and repair the regular furnaces. No sooner were they dismantled, however, than as is usually the case, in came a small, but urgent order. To wait for the furnaces was out of the question. So to hold the trade, it was decided to put in a coke hole. There were a couple of furnace plates on hand, but no shell. In a convenient scrap yard, however, we found a piece of an old boiler, that would answer. So a hole was dug at the foot of the stack, and the work of building commenced. The biggest job of all, to us, was cutting out the square opening for the passage of the flue through the shell; including this, however, inside of three hours the furnace had a fire in it, and there was not a dozen whole fire bricks in the structure, and not a bit of fire clay. The whole bricks were used in the flue, for no cast iron could be used in a steel melting furnace, on account of the intense heat. The shell was just lined with brick bats, and in place of fire clay we used new molding sand, and that furnace lasted two weeks, and we took out two heats of Swedish iron a day. It was the crudest and

cheapest coke hole I ever saw, but it made a record that the best of the elaborate structures we afterwards experimented with could not surpass.

(To be continued.)

Continuous Pouring.

Why is the system of continuous pouring not more generally adopted in foundries having a special class of work in which it may be done to advantage? Some time ago I had the pleasure of going through a number of foundries, and was very much suprised at the large amount of small work to be poured off. It occurred to me that the continuous melting would be an advantage in some cases. It seems to me that it would be more advantageous to bring the molds to the cupola, than the system of taking the iron to the molds, not taking into consideration the large amount of floor space that may be put to other use, in not having the molds all over the floor. By this system of pouring off the molders would be able to start in producing molds first thing in the morning instead of tempering over a large sand pile, and continue to do so all day. There is no need to have skilled help put in one-third of the time doing a class of work that can be done by laboring help quite as well. The pouring can be done by other help than the molder in better shape after a little practice. There are lots of molders practically incapable of pouring any kind of a casting with good results; it is more by good luck than judgment that they get a casting at all.

Some years ago I had charge of a small foundry, running fifteen molders mostly on very light work, for which we had a large number of orders, and were not able to fill them as fast as desired under the old system, and not having room for more molders I decided to try the system of continuous pouring, and was very much gratified with the result. It had been the practice of the molders to temper their sand and pour off, which means that we only got about 7½ hours molding per man each day. After having made arrangements to do all of this work so that the molder did nothing but mold, we got a full 9½ hours for each man, being a clear gain of 30 hours per day molding, or in other words equal to four extra men under the old system; the increased output of the molders more than covered the expense of the laboring help, and not having the castings to clear from the floor and take care of (as the molds were taken out to a shed put up on purpose, where the sand was tempered, and castings put where wanted at the same time) the cost was diminished.

E. J. BAKER.

The Foundry Foreman as a Bookkeeper.

VIRGIL WOLFE.

A prejudice exists in some quarters against the idea that a foundry foreman should keep the records of the foundry. It is claimed that the time taken up in looking over a stack of figures, or figuring out a stack of orders, could be more profitably employed in explaining to this or that molder just how such and such a job should be made. Thus we have the foundry clerk. The foundry clerk is a good thing, but his place should be in the superintendent's office—not in the foundry. In foundries where piece-work is the rule, every foreman should be a bookkeeper; not necessarily a graduate of a business college, but a disciple of the doctrine of the three R's with the accent on the last R. It is easy for a foreman to keep track of all the work coming under his charge, if he only just uses a pad and pencil. It is hard if he only uses his head. No amount of trouble can be saved if it is a recognized fact that the boss of the foundry keeps tally.

For instance, of the many complaints which molders are justified in making is the loose manner in which their piece-work time is kept. In more foundries than one, the molders do not know till pay day comes what to expect for their services. And in lots of cases—and in some more than lots of cases—they don't get what they expected. And then there is a row. The foreman is appealed to, and that passive individual goes and sees the time keeper, or the trimming room boss, or the superintendent or somebody, and the chances are the molder gets his "short" money in a week or so—perhaps.

Now, molders are a bad crowd in many ways, but as a rule they are honest. They want to be treated in an honest manner. They want to know, you know, why this is thus.

There are many good ways of keeping track of piece work in foundries. The great fault in most of them is that the molder is

put to considerable trouble in finding out just how many mistakes he has made in his work, and how many bad castings are charged up to him.

An attempt will be made here to describe a method employed in a well-known foundry in North America.

In this departmental agricultural implement factory the molding shop is looked upon as the most important branch of the business. Important for the reason that the cost of raw material consumed each day is in excess of any other department, and the introduction of labor-saving machinery is attended by greater expense and is followed by slower results, as far as covering the original cost of the appliances is concerned than in most any other part of the works.

The company have their own printing plant and furnish their foreman with all necessary blank forms for the rapid and correct accomplishment of their work. The foundry boss kept what he called his day book in addition to other matter furnished him. This book was a common grocer's order book and was looked upon as his private property. In fact, owing to the soiled appearance it assumed after being in use a short time, no one but the main guy cared to attempt to unravel its contents. So much the better. This was the sacred volume on which he could place his hands and swear he was right.

In this book, in the order in which the molders were placed, were the names of the men, the number of the patterns in use by each man, the order on each piece, the number of pieces (not molds) made each day. Just before the heat the foreman went down one side of the shop from his office and up the other side and took from the lips of each man the number of pieces supposed to be on his floor. This task occupied about ten minutes, with, say, 100 men at work. After the heat was over and the men had gone home, the foreman transferred from his day book to printed sheets containing in numerical order the numbers of the various castings in use on the machines then in course of construction. To copy from the day book to this sheet occupied about 20 minutes. This sheet was kept clean, for it went to the superintendent's office. It was about 10 x 16 and looked something like this:

WORKS OF MAKEALL & HAVEMUCH.

Finished Work Report.—FOUNDRY.

Following castings sent to basement from my department to-day:

GUS HAMMERSTRAP,
Foreman.

	No. Made.	No. Good.	To Basement.		No. Made.	No. Good.	To Basement.
Q 17	340	337	337	X 372	4	4	4
Q 18	127	127	126	X 374	18	17	16
Q 20	17	17	17	X 375	34	30	29
Q 24	1018	946	940	X 381	48	48	48

The first column represents the pieces counted on floor—the second column what the molder got credit for, and the last column the number of pieces to be transferred to the stock books.

All castings found in the gangway were milled, good and bad. The trimming room kept a duplicate sheet, on which was recorded the good work. A single column sufficed for their use. At about 11 o'clock on the second day after the work was made, all bad work was brought to the foundry, sorted out, and placed on the floor in front of the cupola. During the noon hour the molders looked over their bad castings. At 1 o'clock the foreman appeared on the scene. He had previously transferred from the trimming room sheet to his own, filling out the second and third spaces. If molders were entitled to credit for core blows or breakages, the second column was corrected in his favor. Then after all differences had been adjusted, the foreman again went the rounds, calling at each man's floor and told him just how many pieces he was getting credit for. If the molder was wise, and most of them were, he would put it down. And there were few kicks on pay day, as the price list was easily accessable.

Indifference a Bar to Progress.

BY J. TEMPLE McCARTNEY.

To the Editor:

Your article, "Why Don't You Tell It," in the November number of THE FOUNDRY, is an excellent one and to the point. The world is full of "ideas," and many of them lie moldering in foundry graveyards, with this epitaph as a bequest to posterity:

"Departed this life through disinterestedness and indifference—R. I. P."

I undertake the task of presenting an idea to the practical readers of THE FOUNDRY

with some degree of timidity, for the journalistic field is recognized as something beyond the ambition of the average molder; and is supposed to be reserved in perpetuity for scientific superintendents and foremen. This, however, is largely attributable to the indifference and lack of interest on the part of the everyday molder. What cares he for the percentage of silicon required to control the carbon contents of the iron, or if manganese is such a potent factor in foundry practice that it is claimed to be? Such questions are of no moment to him, and evidently he believes they belong to a higher sphere of reasoning than that which pertains to the pounder of sand. He is, however, acquainted with all the fine points of the practical part of his avocation.

Should perchance a "sheeny," i. e., a bad casting, make an appearance, the post mortem examination is in order; a jury empaneled, and a verdict arrived at, with, perhaps, some mental reservations, which are strictly private and not for publication, in so far as any person in authority is concerned.

I remember an instance of this, which came to my knowledge some years ago, and is worth repeating here. A molder was making a 12-inch quarter turn elbow, and after placing his core in position left the straps by which the core was lifted on the core until he should try his cope down (which is a common practice), fully intending to remove them before finally closing his mold; this important part he omitted to do, and the mold was poured with the straps in. Two beautifully formed S's were found on the upper side of the casting, which almost cut through to the core.

Many were the opinions passed on that casting as to the cause for such an effect; but the only man who could satisfactorily explain the mystery reserved his opinion until a long time afterwards, when it was given to me gratis, and exploded all the other learned opinions, and proved conclusively to me that there is such a thing as mental reservation in the foundry!

There are many molders who can make a casting from any pattern given them, but how few, comparatively, can determine mathematically the weight of the casting to be made.

He would be an anomoly in the foundry who should depart from the unwritten law that the foreman should compute the iron required to pour a casting, and why this should be so is incomprehensible; the opportunities for enlightenment and progress being illimitable in this age; and it only requires determination to grasp them. A paper or a book devoted to the interests of the trade is tabooed by molders generally, because it treats on something with which they are familiar, and that old adage, "Familiarity breeds contempt," is applicable to a molder and a trade paper. True, there are exceptions, but the rule is indisputable. Of course, every molder can't be a chemist, nor is it expected; but in the nature of the occupation in which he is engaged, it is imperative to his success as a mechanic that he should be acquainted with some of the principles of geometry, and the more he shall employ his mind in searching out the higher principles that pertain to iron founding, the better for himself and for the trade generally.

Human Nature in the Foundry.

BY H. R. RAMP.

"Handling men" in the foundry, as elsewhere in the busy marts of life, is one of, if not the first, requirement exacted from the foreman or man, in whatever capacity he serves as an overseer, as the measure of his value, the greatest compliment to his ability.

Mechanical ingenuity, experience, wisdom, all fade into insignificance when compared with this one all-necessary, all-powerful attribute that must be possessed by him who would gather up the threads of an establishment and direct the wheels of industry to turn, and "handle" and direct the hundreds, yes, and often the thousands, of human lives, I might say human machines, to move and act and carry out the designs, the systems, the plans, which result from careful study and judgment.

A man may possess the ability to execute himself the most difficult and intricate piece of work that can be brought to him, successfully and quickly; he may be able to plan and design improvements which are worthy and possess great value, but unless he can inspire, or help, or "handle," call it what you will, the men who are employed by him or under his control, to vie and develop the things he is able to bring forward as assistants to his business, he will never be a success as a director, as a leader, as a foreman.

How often we have witnessed one shop or one plant take work at a lower figure than

its competitors, and come out whole, and yet be not nearly possessed of the facilities and improvements they bid against. The loser generally consoles himself that the other firm took the work cheaper because they cut their men or compelled them to work for starvation wages. The other day I entered a shop that was making car wheels, not one of the up-to-date wheel foundries with all the modern appliances and fixtures, but simply a good, well established, fairly well equipped shop with a good foreman and a good system. They made wheels, yes, and good wheels, and competed in the market with the best, yet every part of that establishment moved so harmoniously, so unitedly, every man appeared to be doing his duty, there was no shirking, from the laborer to the foreman, that they produced their castings, made their profit and paid their men as good wages as any plant in the country. And there was no reason for it, but that the foreman and his men were in touch, were working together, whether they knew it or not. Wonders can be accomplished with a willing heart, prices can be reduced and wages maintained more easily through kindly treatment, through a just consideration of the fact that the labor of this country has rights and privileges as well as any other thing in this broad land, and by dealing with the men as though they possessed some of the qualities that are supposed to find lodgment in the human breast.

I know that strikes or labor troubles often bring out all the bad there is in a man's heart or make-up. He may violate the laws of his country, he may do things which are all wrong, but the employer at such times is often no better. True, he may not resort to open violence, but he will make that poor, hungry workman feel the weight of his displeasure through his influence in depriving him of some new situation he may acquire, through the black list or kindred methods, which are all un-American. But where you find the successful firm or company, you find the manager or foreman in whom the men trust and regard as their friend; you find the heads of the establishment men who are inclined to regard the condition of their employes as a part of their business, as a part of their life.

A smile, a word, a favor, from an employer to his humblest employe, has often been more productive of a return in dollars and cents than hundreds spent in improvements. Aside from the fact that we are all brothers of the great human family, and should help each other, it pays to look after the interest of the employe of this land, and pays well, and the successful "handling" of men is only accomplished by first winning their regard, and making them feel and know you have some interests in common.

Of course, it is not to be assumed that the ignorant foreigner, the man who is prejudiced against every one who possesses more than his day's wages, will be converted and become docile and the most faithful of workers, but such treatment will, even with those, reduce their antagonistic propensities, and not add fuel to the "fever of their discontent," like a harsh, dictatorial policy would.

And besides, the man upon whom fair, honest treatment has no effect, does not deserve to receive his daily bread from the fruits of the capital he so heartily condemns.

How near alike we all are in sympathies and in natural conditions. Education or position may rear a wall between us that we may never penetrate, but there is one great bond of brotherhood that does bind all mankind more closely together than they themselves are aware of. The interest of the man with shovel and the rammer, the interest of the employer with his business and its attendant worry, should be cemented in an indissoluble union of interests that are in reality one.

It is true, man is made in all lights and shadows, some born with propensities slightly warped in this or that direction, a diversion of character that causes our likes or dislikes, that creates the preacher, the business man, the mechanic, that is sometimes the making of a business, sometimes its downfall, but with it all we are all striving, as every one thinks best, for one end, an honest and decent livelihood.

We know business should be conducted on business principles, that sentimentality or soft-hearted generosity would not be enviable qualities in the head of a concern or in a foreman, from a financial point of view, yes, or a truly beneficial assistance to the toiler himself. When a man does not do his day's work or perform his duty, the omission should not be overlooked. Because a man sees fit to solicit charity it is not advisable to carry him and shield him as you would a hothouse plant. But it is necessary that those at the head of a business should understand and study human nature as

much as the details of their business, if their progress and success is expected to be lasting. The employer, the director, must study his tools as much as he does his product and his monthly report, and in the shop and factory the employe is more the tool than any other article, a tool of greater value, of wider adaptability, of finer texture or quality.

Yet he is often housed more poorly, regarded more meanly than any piece of mechanism that stands upon the possessions of the company. The fine tool is wiped and cleansed, and oiled and repaired, when occasion requires it, yet the human tool may suffer and decay, when a trifling expense or effort would have placed it in a position of infinitely more value to its employer, and it will be a step in the direction of the solutions of many of our vexatious problems when employers and foremen, who speak of their employes as "our men," regard them truly in the sense they speak, and their efforts will never lose them a dollar either.

The laborer or mechanic of this country is regarded too much in the light of a mere machine, and, as before stated, as a machine which you rent, not one that you care for and own; his toil is to be bought or sold, and his labor ruled and governed by the rules and formulas laid down by his employer. You can build a machine which will make so many revolutions per minute, or turn out so much work, for so much horse-power applied in a given time; you can build it so it will be accurate and exact, and figure your profit before taking a contract with great accuracy. But when man takes the place of a machine you are dealing with an unknown quantity. You apply so much horse-power in the form of wages, and expect or demand so much in return in labor and of a specified quality. This is purely a business transaction, so much pay for so much work, and appears just and sensible, but when you apply horse-power to a man the same as yourself, it is an entirely different thing from applying it to a piece of inanimate machinery. It may far surpass your expectations; you may be purchasing a human tool that will bring credit to your work and dollars to your pocket; you may purchase one that is the reverse; but however that may be, when the heart of the employe is in his work and for those for whom he toils, the product of his efforts are sure to be better and finer and greater. No matter if the man be humble, ignorant or poor, yes, or vicious, follow Chas. Reade's advice and occasionally "Put yourself in his place;" remember that every man has an ambition, be it ever so humble; remember that every man has sensibilities, no matter how dwarfed or hampered or blunted, and that the care of the human being who makes your business a success, while your capital or knowledge may give him bread, was prior to and has greater claims upon the consideration of the successful man than is usually recognized.

It is not to be expected that an establishment which invests so much money is doing it for benevolent purposes or to maintain a home for so many workmen, that they are in business for their health, or any such kindred purpose, but, when they seek to sell their product to the public, they inquire into the needs of the same, and study how they can advertise so as to appeal to the reason and the judgment and the pockets of their would-be customers; they are willing to help their customers, to grant them favors, to meet them pleasantly and as equals, and methinks 'twould be well and practically a paying investment also if the same courtesy, the same solicitude, were extended to the man who produced the goods and who is as truly a money-maker as the buyer, and we know is more susceptible to good treatment.

Metal Borings.

Waterbury, Conn., Dec. 19, 1898.

To the Editor of Foundry:

In reply to your query, "Why don't you tell it?" in the November FOUNDRY, I will say a few words about my experience with cast iron borings.

Some few years ago, while in charge of the Reliance Engineering Co.'s foundry, at Aurora, Ill. (the old Hercules Ice Machine Co.'s works), I conceived the idea of trying to use cast iron borings in the mixture for our cylinders and other ammonia castings, which required very strong, close-grain metal, with the following results. After finishing our heat and drawing out all the metal there was in the cupola, I put on a fresh charge of coke, then charged on 2,400 pounds of cast iron borings; then put on the blast to seven ounces pressure. In thirty minutes after putting on the blast the stuff was all melted, and down in the bottom of the cupola. The metal came out very hot and fluid, and we cast it in pigs made for

that purpose. The next day we weighed the product and found, to our surprise, that out of the 2,400 pounds charged there was 2,143 pounds in good solid pigs. After putting on the borings we covered it up with coke, and not having a very strong blast, perhaps saved some if not all from going out of the top of the cupola. But, in the meantime you could see nothing but thick, black oil smoke coming out of the cupola at the top. We were using Ohio Scotch No. 2, National No. 2 and scrap, with from 10 to 30 per cent of soft steel scrap for regular mixture, which was giving perfect satisfaction. My idea was to find out the waste in the melting of borings and if we could add it to the mixture with good results. Test bars one inch square, twelve inches between bearings, cast from our regular mixture, broke at from 2,700 to 4,200 pounds, while similar bars cast from a mixture with remelted borings added instead of steel scrap broke at several hundred pounds less on the average, though the grain of the iron appeared about the same. The pig cast from the borings looked in the fracture like chilled iron, though it was stronger, and after experimenting it was found that about 20 per cent of the remelted iron could be used in the mixture successfully.

There may be other and better ways to charge it. I am satisfied with the way I have used it. This pig cast from metal borings will take the finest chill I ever saw, in such work as rolls or car wheels, with regular chilled mixture; it has very little shrinkage, and for that reason is good tonic for anything that is liable to chill crack.

In my opinion, in heavy work from 10 to 20 per cent of steel, charged in the cupola with the rest of the mixture, will produce better, cleaner and stronger castings than without it. Your per cent of steel must be in proportion to the weight of casting.

B. F. CHAMBERS.

Explosions.

By R. D MOORE.

Under the head of explosions may be classed a great variety of phenomena witnessed every day in all metal foundries.

Most persons have only a dim conception that water and gas, in some mysterious way, is responsible for this dangerous violence. It is a matter of considerable importance, both for the safety of the person and the work under manipulation, that persons handling fluid metals and subject to these explosions should clearly understand their nature and how they are produced.

I propose to enumerate a few sample cases, such as are of most common occurrence, with an attempt to explain their true nature.

The power displayed in these explosions appears to grow out of two general gas expansions; one is the extremely rapid generation of steam, which can only take place when a very small quantity of water is evaporated from a merely damp but hard surface.

The other source of power may be called the extreme expansion which takes place when certain gas compounds are ignited and consumed.

Many modifications of these powers are exhibited, as well as compound expansions, as is shown in the explosions on igniting the gas in the core of a loam cylinder when poured. The gas of a brick loam core not thoroughly dry will explode with a much greater force than gas from a core of the same make with the water all evaporated, as when dried in a good oven, evidently the result of a larger proportion of steam combined with the gas when not thoroughly dry.

All persons that have handled melted iron have noticed that when spilled, even in very small quantities, under some circumstances, the metal is thrown up from a damp floor with a violence indicating considerable explosive force generated at the moment of touching the floor.

Pour melted iron slowly into a vessel of water or wet mud, and the steam generated will be condensed immediately and no explosion can take place.

Pour melted iron in a pile of loose damp sand, and the steam generated escapes rapidly into the sand pores until condensed, and no explosion will occur.

But ram that same sand as hard as a foundry floor and on dropping iron from two feet high on its surface, the steam generated, not being able to escape downward through such a compact mass, escapes upward against the fluid metal with a force sufficient to throw it several feet into the air.

Drop melted iron on a dry metal plate and the movement will be simply mechanical, such as would be produced by pouring cold quicksilver under the same circumstances. Add a very small amount of moisture to the surface of the plate and drop melted iron on

it, and the iron will be thrown upward with a force much greater than from the hard sand surface, for the very good reason that there was no possible escape for the steam downward.

The blacksmiths have a trick, when they want to "show off" before a stranger, for clearing their anvil of scales after heavy forgings, by a steam explosion which is evidently upon precisely the same principle.

After working heavy forgings upon an anvil until it and the sledge becomes considerably heated, he drops a globule of spittle upon the center of the anvil, then bringing the face of the sledge square down suddenly upon the globule causes it to spread out very thin between the two heated surfaces.

Just at the moment the sledge touches the anvil the thin film of moisture is instantly converted into steam, and so suddenly as to amount to an explosion of sufficient power to sweep all the scales off the anvil.

A very simple but interesting device for stirring and mixing metals in a ladle is had by forcing a raw potato or any such moist and tough substance upon a sharp rod and passing it in and around the bottom of the metal causes it to boil violently but harmlessly.

The steam in that case can only be generated with moderate rapidity and great regularity, and finding an easy outlet through the fluid, yielding metal, the force is defeated, and no damage is likely to result.

Immediately before the immersion the bar should be heated to prevent any moisture from the potato covering the bar, as a violent and dangerous explosion would result. This trick is not "highly recommended," but is given as it throws light on the subject of steam generated under different circumstances, and the consequences.

Almost every general molder of experience has witnessed what may be called violent gas explosions, which occur in green sand molds when nearly or quite poured.

They don't appear to be confined to any particular class of molds, but occur in the plainest plate molds as often as in the most complicated or confined.

These explosions differ entirely from ordinary blows, and can be distinguished by its sudden burst and great power, which is all expended in one instantaneous outburst, often carrying the cope sand out of the bars and trying the strength of the clamps.

These peculiar explosions may be said to occur very rarely, only one case in some thousands of molds that are cast, but sufficiently often and destructive to merit the molder's careful attention.

A case will illuminate the subject: A plain plate 15 inches wide, 16 feet long, ¾ inch thick, for a 3-plate building column, exploded at one end, two feet being so strained out of size that it could not be used, while all the other parts remained perfect; the probable explanation being that the force did not last long enough to reach further. A satisfactory theory for this peculiar phenomenon is not easy to reach. After much study and consultation with thinkers the nearest approach to a satisfactory theory is that it is the explosion of a favorable mixture of gas and air in the pores of the sand. Suggestions from some of your numerous readers would be interesting reading.

Very violent and dangerous explosions sometimes occur under a cupola furnace when the stock is dropped out of a heat, technically called "dropping the bottom."

It is very rare that all the conditions for a violent explosion are present at any one time, the writer having only witnessed one of a very dangerous character in many years of foundry life, but they are of such a serious nature as to prompt the foundryman to stand out of shot range. The case witnessed exhibited a violence almost beyond belief, throwing melted slag with considerable force against objects one hundred feet from the furnace.

The workmen were all so fortunate as to escape serious damage, with one exception. He was plastered on the back with melted slag and burned to such a degree that he was laid up for several weeks.

After witnessing the occurrence and examining all the facts and circumstances, the conclusion arrived at was that it was brought about in a manner similar to all the other violent steam explosions treated of, namely, a very small amount of water suddenly converted into superheated steam while under confinement.

The time was in the middle of a cold winter and the shop had been shut up for two weeks and the ground under the cupola frozen hard.

The heat from the cupola on that day had thawed a thin crust of the rather dry ground and developed a very little moisture on the

surface only, and, of course, steam tight below this thawed skin, the very condition for a violent explosion.

The sand bottom fell on the floor very level, the slag instantaneously flowing over all the edges at the same time, forming a complete confinement of the steam generated from the hot bottom touching the slightly damp floor.

The considerable load of stock on the unbroken crust would give such a resistance to an uplift that the soft fluid slag flowing over the edges would easily become the flying missile of such an explosion.

A correspondent of the Scientific American once asked for an explanation of a similar case showing greater violence, tearing half open doors off their hinges, etc., but, I believe, received no reply.

The following quotation from the "American Manufacturer" of a past date, will be very interesting in this connection, as it confirms the theory and facts here presented, and also shows how totally the mill men have failed to reach the philosophy in the case, even after observing the facts so closely.

It refers to the explosion of white hot puddled balls when being dragged from the furnace to the hammer or squeezer along a "raceway" of iron plates. I quote:

* * * "We have never heard the cause defined or why a ball explodes in a comparatively dry place more than in water, and why the explosion of a fine metal ball makes a louder report, and its effect is more powerful than a spongy ball from pig iron.

"The general opinion is that the explosion is due to the instantaneous generation of oxygen and hydrogen gases in explosive proportions, which will rend a ball into thousands of pieces. These explosions occur more often at the joints of the race plates, where damp or wet dirt had accumulated, more so than at places where water was lying on the plates; but in each case percussion by the ball striking against the plate or dirt appears to develop the cause. * * * How gas, which apparently is formed outside of a ball of iron, can rend it to atoms is a mystery, but this it does."

The above quotation carries two masterly specimens of absurdity; one is that gas can form, like lightning, on a ball just out of a white hot furnace; the other is that it could rend a ball from the outside. The theory given in the above foundry explosions is palpably the true one, the same circumstances being present, namely, the sudden conversion into steam of a very small quantity of water while under confinement.

To Make a Name Plate Pattern.

To fit up a brass name-plate casting for a pattern by filing involves a good deal of labor, besides necessarily reducing the face of the letters too much, if sufficient draught is given.

Instead of using the file, just lay the plate, face up, on a level bench; then melt some beeswax on it with a blowpipe, continuing the application of the flame till the plate becomes hot; then let it cool, and your pattern will be ready for use.

If you choose to make the complete pattern without buying a casting for a starter, simply locate letters and figures to suit your fancy on a brass or iron plate and melt the wax upon it; when the wax cools it will be found to coat the whole surface evenly, giving the requisite bevel to the edges of the letters, filling narrow, difficult pockets so as to make them more shallow, as desired, and the letters will be firmly fixed to place; then make a casting from this and coat it thinly with wax and you will have an excellent pattern at nominal cost.

This trick of melting wax onto patterns may be employed in many instances where draught cannot be otherwise conveniently given.

Leveling Down, or Up?

The "American Manufacturer," in its issue of December 16, in an article on "The Basis of Wages," says of the "time-wage" system that its worst feature is that it has a decided tendency to level down instead of up, etc. One of the most determined and successful opponents of the trades-union that we ever knew made the above a principal argument against them. He had no union men in his shop, while the foundry across the road from him was a strictly union shop. The highest day wages that he paid for molding was $1.50; the highest paid in the union shop was $2.75. He claimed that his chief objection to the union was that it put all the workmen on a level, and prevented the good man who was worth more from getting the just reward for his extra exertion.

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Trade Outlook.

The American business man is naturally an optimist. In the darkest hour of industrial stagnation he has never failed to look forward confidently to a speedy return of prosperity that would enable him to recover all his losses.

The character of our industrial history has been such, however, as to develop a tendency to yield too often to the influence of sentiment rather than to the more modest dictates of sense. Not that the American has not as ample store of good sound sense as characterizes any people on earth: but the vicissitudes of business affairs have, in this country, varied so greatly; to-day, rising in a continental swell of unparalleled prosperity; to-morrow, plunging into a vortex of economic demoralization; yet like "Pip's" antagonist, who stood on the left foot with the right thrust back, and anon upon the right, foot, with the left in air to the rear, and squared off like the scientific fighter that he would be; and who smiled as interestingly after a stunning blow on the jaw as if his favorite sister had kissed him; and who shook hands with "Pip" as who should say, "Don't be put out by a little thing like that, my boy; keep up your courage, and let's have another round!" So, from the chaos of industrial wreck the American business man bobs up serenely!

But, isn't it about time to quit this seesawing?—have not the periodical ebb and flow left with us lessons that should enable us to sail upon a more even tide than heretofore? Yes, undoubtedly; the industrial symptoms that now prevail plainly show that sense is at the helm. But there are minor symptoms indicating that sentiment is gaining ground in some quarters, and, in view of past experience, one is moved to say to the Sancho Panza element of the business world: "The Lord deliver me from my fears that thou wilt turn the whole—continent—topsy-turvey!" Never, within the memory of the active business men of to-day, was the situation so favorable for solid, enduring advance in all lines of production and distribution; and, if we shall succeed in quelling the gambling spirit, which prompts to speculative plunging, trusting to chance for a favorable outcome, and if we shall, on the contrary, confine ourselves to those activities for which a cash demand appears, supplying that demand with full value received, then indeed will the near future bring to us blessings manifold, generally and evenly distributed among our people of all classes, happy in the consciousness that we have dealt honorably with all, and that we are not undeserving of the good fortune that rewards such conduct.

Diagnosis.

The foundry and the human system are much alike in that the causes of certain effects are difficult to determine. For this reason, the skilful founder will manage successfully without any great effort what to another presents many insurmountable obstacles. A very few simple principles underlie all scientific or mechanical processses which, if properly observed, will make easy work for all concerned; but, if these are not first mastered, no amount of knowledge of other details will supply the deficiency.

In medicine a correct diagnosis might insure speedy recovery of the patient, whereas equal knowledge of medicine, under mistaken diagnosis would be unavailing. The same is true in the foundry. If a board run through the planer be too thick, the foreman of the wood shop knows at once the reason; but if a lot of castings present a similar defect, the cause is not so easily determined. Perhaps the molder is not ramming hard

enough; perhaps the bottom board is weak; perhaps the weight on the cope was insufficient, or the cross-bars were not strong enough; or, the iron may have been poured too fast; or, the iron may be too hot to-day and too cold to-morrow, turn about, day after day, thus making it impossible for the molder to acquire the habit of pouring rightly. And this last is what we wish to dwell upon just now. It touches upon one of those simple fundamentals of good foundry practice that, rightly observed, will cure many difficulties.

Good mechanical habits are of the highest importance; they insure success almost without an effort in all ordinary processes, and leave only the extraordinary to be specially looked after by the workman. This applies with special force to molding and casting. Let the man who has been accustomed only to gray iron take a floor in a malleable shop, and he will lose half his work from not pouring rightly for the first day or two, and it will take him several weeks to become expert. This shows that the iron should be melted at a practically uniform temperature every day; and no matter how intelligent, skilful and painstaking the molder may be, he will lose castings as a direct result of marked variation in the temperature of the iron as it comes from the cupola.

Jumping at Conclusions.

A young molder was making sleigh shoes in the foundry of Densmore Bros., Redwing, Minn., and the whole day's product had swells on the bottom. He thought he was not ramming hard enough; but the next day's work was worse than before. Starting in the next day with a determination to ram so hard that there would be no possibility of swelling; when he drew the first pattern he noticed a crack in the mold at the lower angle. What was the matter? Simply that the bottom boards had been long in service, had become burnt, and so weak that the weight of the sand bent them. Many an old molder fails in diagnosis as badly as did this young fellow.

The molder should never jump at conclusions; but, whenever a difficulty arises, he should take under consideration every circumstance that might possibly cause it. No doubt some molders do this—and there are some very successful molders.

The Price of Pig Iron.

An exchange asks, "Will the conservatism of the great producers of pig iron stand the tension of the strong demand?" While the question was being put into print, the southern furnaces were putting up the price twenty-five cents per ton. As a matter of fact, the great producers of pig iron are greatly averse to raising the price beyond the point that will permit of its profitable exportation. The dream of the past few years has been that the cost of producing pig iron in America would yet be beaten down so low as to permit of a heavy export business; and now that the dream has "come to pass" there will be much reluctance to do anything calculated to lose us the markets so hardly won.

One of our merchant princes gave as a principal means to his success the fact that he always sold at a small profit, and so prevented competition. There were times when he could have made a fortune in a few months simply by charging all that he could have gotten; but he well knew that this would have encouraged others to launch out for a share in the large profits, and the fierce competition that must surely follow the over-supply would wipe out fortunes faster than they had been made.

The fixed capital required in the production of pig iron is so enormous that the greatest care should be taken to avoid any encouragement of expansion beyond legitimate demand.

It is quite probable that, under the influence of rapidly increasing demand, the price of pig iron generally will advance, to some extent; but the true interest of all concerned is to prevent this except in so far as may be necessary to cover increased cost of production; even the increase of price on export iron, where this is possible, is of very doubtful expediency, for this would simply court the competition of foreign producers.

The furnace operators may congratulate themselves on the obvious fact that they are going to have all they can possibly do for a long time to come at remunerative prices.

"Irregular Attandance at Work."

The above is the caption of an article in the Iron Founders' Monthly Report, of London, England.

The writer had been in conference with several firms, with a view to getting an ad-

vance in molders' wages, and the firms represented on the "Conciliation Board" stated that they would have no hesitation in granting the advance sought for if they could be assured that their foundries would be worked anything like 53 hours a week. The writer further admonishes the moiders that "this losing of time goes to prove that you are not taking all the possible advantages of the present good trade," etc., etc.

The employers also stated that the molders were "absolutely the worst timekeepers in their employ."

This is a clear case of the workmen's preventing an increase in their wages by simple disregard of their employers' interests.

Put the increased wages that would arise from steady work at full time together with the advance that the employers would concede, on the above condition, and we have the standing penalty, imposed on each succeeding pay-day, for absolutely indefensible misconduct.

The rate of wages that an employer is willing to pay is determined largely by the rate of profit that he is realizing. If men do not show any regard for the interests of their employer, but, on the contrary, evince a total disregard therefor, he certainly cannot be justly blamed if he declines to reward them for it.

The American molder may learn a lesson from this. The stickler for "personal rights" may answer, "whose business is it if I take a day off when it suits me to do so; and if I choose to spend my money for beer and whisky, isn't it my right to do so?" But, my friend, there are certain consequences that will surely follow this sort of thing, and among them will certainly be a lower wage rate than you would otherwise get. It is not wise always to stand out for all of one's personal rights. The individuals of society are inevitably dependent on one another, and the more agreeable we make ourselves to those on whom we most depend, the better for us. The average employer is not a heartless tyrant, seeking to rob labor of its just reward; he is simply a man who, some of the time, is trying to make a profit on his capital, and at other times, trying to keep from losing all of his capital in hopeless bankruptcy. He needs the sympathy and helpfulness of his employes, and they will, by giving it, put money into their own pockets.

A High Ratio.

Not 14 to 1, but probably as good as anybody else can do, and much better than the average.

The credit that attaches to a high ratio of iron to fuel in cupola practice depends largely on what the iron is to be poured into after it is melted. As is well known, stove plate requires the very hottest iron for successful casting, and this necessitates a higher per cent. of fuel than would be required for general machinery work, according to general practice, though we are of opinion that better results follow the melting of iron hot for all purposes.

By the courtesy of Mr. D. H. Truesdale, superintendent of Cribben & Sexton Co.'s Works, Chicago, Ill., we are enabled to present the following statement of a heat made in the foundry of Cribben & Sexton Co., November 22, 1898:

Lbs. iron melted, 53,610; lbs. coke consumed, 6,150; ratio of iron to fuel, 8.70; Blast started, 2:45; Blast stopped, 4:30; duration of Blast (minutes), 1:05; melting rate Blast (minutes), 1:05; melting rate per minute, 510 lbs.; melting rate per hour, 30,600 lbs.

The cupola is what is known as the "Truesdale" cupola, and lines up 48 inches across the tuyeres and 66 inches above tuyeres. It is somewhat larger now, as it has not been re-lined for over a year, and will probably measure 52 or 53 inches across the tuyeres and 70 or 72 inches above.

The class of castings made consists principally of light stove plate, making it necessary to have hot iron, as we carry a large portion of it 250 feet in a "buggy" ladle, holding 1,800 lbs., and pour from that to hand ladles.

We use two tap-holes, one for "hand" ladles and the other for the "buggy" ladle. Both holes are ¾-inch diameter.

The stream for hand ladles was stopped once during the heat, and enough melted metal would accumulate to fill the "buggy" as fast as it could be emptied and returned to cupola.

The above example is not selected as being extraordinary, but fairly represents the daily practice in this foundry, as may be verified by anybody who may wish to investigate.

I think THE FOUNDRY is a gold-mine of information to anyone engaged in foundry work. R. SCOTT.

Coring Small Cotter Pin Holes.

Some time ago a correspondent asked how to economically core very small holes, say 1-8 inch at one end and 3-16 inch at the other. There is nothing easier if the hole is not too long. Suppose you want a cotter pin hole through a casting 3-4 inch diameter. Do not think of using a sand core; make the core of cast iron, and you can use it many times over. The core, or die, should be very smooth, and must be tapered a little. To prepare it for use, oil it, and coat it with silver lead. This can be very quickly done. Say you wish to use one or two hundred today: Place them on a plate and pour on some oil, and roll them about until thoroughly covered, then place them on another plate and roll them about in silver lead till well coated. If the dies are true and smooth they will remove from the castings with ease.

TO MAKE THE DIES.

Take a piece of half-inch round iron, 5 inches long, and on one end of it turn the die just as you wish it, except that it shall be one-eighth inch longer than required. Provide a cast iron plate 1-8 inch thick, and as large otherwise as you can successfully cast in the snap mold that you may use; drill 50 or a hundred holes in it that will easily take the die; mold it up, setting the gate pin right on the center of the plate; lift the cope and punch through the holes. If this is very carefully done and the sand in the drag has been riddled and rammed properly, the dies will be true and smooth. The resultant casting will be, of course, a plate with 50 to 100 spikes on the bottom side Simply knock them off with a hammer clean, oil and coat with silver lead and they are ready for use.

If you give this job of making the dies to a careless molder you will have trouble with them. The punch must be thrust straight down, and withdrawn with equal care. The writer once gave the job to a "good" molder, for he wanted some dies in a hurry. They were poured at the beginning of the heat, and shaken out as soon as cold, and there were hardly any good ones in the whole lot of a dozen molds. The "good" molder affirmed that he had done his best, and that he did not believe they could be made any better in that way. The writer, who was foreman of the shop, immediately put up three molds himself, and got about three times as many perfect dies as were in the dozen molds above alluded to. In short, careful molding will produce good results in this as well as in anything else.

Making Core Prints by Means of Dies and Punches.

In the December issue of THE FOUNDRY Mr. Moore gives an example of how he astonished a customer by accurately coring holes in the flaring collar of a cylindrical casting at an angle of 45 degrees from the line of draft. Instead of having a core print on the pattern, he had holes drilled in the pattern exactly as they were wanted in the casting. Just before withdrawing the pattern he dug out some of the sand from the hole and then inserted a punch of the same length as the core, thus providing a print perpendicular to the angular part of the casting.

It does not appear when Mr. Moore first employed this means of making a core-print, but the practice has been common for many years. All castiron plow standards are cored in this way, to make the holes for the

FIG. 1.

share and the mold board. The landside prints cannot be reached with a punch, and neither can fixed prints be used. In this case, long taper dies are used. In molding a plow standard, the mold board side is coped off, the land side extending down into the drag. Heel, or finger prints, as Mr. John M. Richardson calls them in his article on "Core Prints," in the December FOUNDRY, and which, by some, are called bank prints, might possibly be used here; but the great length of print necessary in order to get a half-inch hole through a three-eighth inch section would be extravagant, even though we ignore the resulting imperfect face of casting, which would have to be trued up on the emery wheel. The taper dies run through both faces of the standard pattern, the large end being beveled to conform to the moldboard face, and being, when set in place, flush therewith.

Figure 2 is a view of section of a casting through the die holes, with the die in position. At b is the stop attached to the die to

hold end of die even with face of pattern; at c is a small hole in large end of die, represented by dotted lines; a vent wire is thrust into this hole to withdraw the die. After this has been done, and the pattern has been drawn, a core a trifle smaller in diameter than the die at a, will be thrust into the hole at c and pushed to the small end of print by following it up with one or more cores of the same size, according to length of hole. The last core inserted should lack somewhat of filling the hole, so as to permit of truing the surface of the green sand core of mold with sand. Thus we are able, by means of

FIG. 2.

straight cores, to cast a hole anywhere on the drag side of the casting at any desired angle. In some cases it is preferable to run the die through the side of the flask instead of through the opposite section of the pattern, and this is very frequently done.

It is important to bear in mind that the die at a, must be somewhat larger than the core; otherwise, the latter will push off some of the green sand from the mold and a hump of iron will take its place, and a dirt-hole will appear at the bottom of the casting.

Answer to Eug. Smith.

B. C. VICKERS.

I have never heard of "Fluxin" or Iron Fiend, and though I may be possibly behind the times in this particular, I do not believe in such a thing, as it looks to me suspiciously like an advertisement of a "royal road to learning." The only thing that I know of that can be relied upon to take iron out of brass is labor, and, sometimes lots of it.

When the brass is in the form of turnings the iron may be removed by magnets, either by hand or machine. In the case of brass scrap, containing iron rivets or screws difficult to remove by hand, a good method of extraction is to melt the scrap, keeping the metal at a low temperature (it must never reach the smoking point) and, as soon as sufficiently fluid to run into ingots, remove from the furnace and skim off. Stir and repeat the skimming several times, after which run into ingot, and proportion the ingot amongst the new metal, or run into castings that are not to be machined.

By keeping the metal at a low temperature, we, to a great extent, avoid melting or oxidizing the iron, which being lighter than brass, rises to the surface and is removed by the skimming process.

ANSWER TO R. C. PAUL & SON.

The reason why large brass shops do not use the cupola for melting, is, I believe, largely a matter of tradition. The crucible method is the best, and possibly the only feasible one for making small brass castings, and, when the small shop grows into a large one they multiply or enlarge their furnaces, and continue in the same old way. While new shops starting up follow the methods of their competitors, I see no reason, however, why, for the production of large castings, or large quantities of "chunky" castings, the cupola should not prove to be more economical and more convenient than crucibles, as we could afford to lose a little more metal because we save the cost of crucibles, and economize in fuel. Of course, the cupola must be run intelligently, as there is a considerable difference between the melting point of copper and iron; if we run the cupola at the same temperature for copper as for iron, we are going to burn or oxidize the metal, as in the case of the phosphor bronze mentioned, for instance.

Gueltier, in his "Metallic Alloys," page 49, makes the following remarks on the use of the cupola for brass:

"The essential conditions to obtain from cupolas a well alloyed metal, producing sound castings at a proper temperature, may be thus summed up:

1. To employ a dense coke, whose broken fragments are of a volume somewhat small-

er than those for the fusion of cast iron.

2. To use a cupola of medium height whose dimensions in the clear are those of a cylinder having a diameter one-fifth of the height, and one or two tuyeres, one opposite the other, giving the blast under feeble pressure; the cupola must be carefully heated before the introduction of the copper.

3. To make smaller charges than in the case of cast iron.

4. To attend carefully to the tuyeres, in order to be ready to tap off the metal as soon as the last drops of the last charge fall on the hearth.

5. To pour the copper upon the tin already in the casting ladle.

6. To stir carefully and continuously while the copper is running into the ladle, and the mixture is being effected.

7. To cover the surface of the molten alloy with ignited charcoal.

—In the alloys where zinc is a component part, it is proper to melt the zinc in a separate vessel, to pour the molten copper into the casting ladle, and, after having covered the latter with charcoal, to let the zinc into the copper through an opening made in the charcoal.

This same hole is used for introducing the iron rod or wooden pole used in stirring. An operation thus performed by using the necessary precautions for obtaining an intimate mixture without oxidization or volatilization of the more fusible metals; by managing the fusion of the copper so as to make the minimum of waste; by adding to the copper in the cupola a few ingots of bronze or brass, old runners, etc., which prepare the copper to be alloyed and give it a fluidity which alone it would not have—will permit the casting of thin pieces in a satisfactory way more rapidly than by the use of crucibles, or reverberating furnaces, and, at all events more simply and economically.

* * * When we melt in a crucible the filings, turnings and scrap metal, the waste may go as far as from 25 to 30 per cent., and it is difficult to obtain a metal pure enough for casting. It is therefore necessary to make ingots, which are melted again, and produce another waste of from 3 to 5 per cent. In a cupola, these scraps, kept enclosed in old copper pipes, or enveloped in rough boxes made of old sheet copper or brass, do not produce more waste than in a crucible and the metal is hotter. * * * With crucibles the waste varies with the greater or less skilfulness of the founder, and, excepting accident in some special cases, remains between 3 and 6 per cent. In cupolas the waste ranges from 4 to 10 per cent. and in reverberating furnaces from 6 to 15 and even 20 per cent."

Cast Iron.

By DR. R. G. G. MOLDENKE.

The recent tests of cast iron columns made under the auspices of the building department of New York, brought out very forcibly our comparative lack of knowledge and skill in handling a material which should be peculiarly well adapted for this class of work. The practical condemnation of cast iron for even the simplest of structural members under stress is the natural consequence of the uncertainty existing in the mind of the engineer and founder regarding the interior condition of an otherwise good looking casting.

In carrying out the numerous processes incidental to the preparation of steel shapes from the furnace to the erecting shop, a continuous watch may be kept upon the behavior of the metal, imperfections detected with some degree of certainty, and such material at once removed. With cast iron, however, we are practically in the dark and must depend upon our best judgment and experience. The reason for this state of affairs lies in the great lack of homogeneity in cast iron, this being all the more noticeable as unlike steel it is not subjected to subsequent treatment which, if properly carried out, should remove internal strains and leave the piece amenable to the laws of applied mechanics.

But for the manifest advantages of a material which can be cast into any conceivable shape readily and with a fair chance of success, where would a factor of safety of 20 be tolerated? We are hardly ready as yet to accept machinery built of structural steel as long as the superior stiffness of heavy cast iron frames and beds is not counterbalanced by too great a cost. This, moreover, in spite of the fact that we have to reckon heavily with the internal strains and consequent warping tendencies of large castings in machine design and construction.

The modern tendency is to raise the elastic limit of the materials we work with in order that a saving in weight may be effected. Note the astonishment of European engineers

when they see our bridges and structural work in general. They call it airiness, and lack of solidity; we, on the other hand, deal with the highest grade of materials and keep the standards at the top notch. There is wisdom in this economy, for greater care bestowed upon smaller quantities leaves us the more of our natural resources to draw from in the desperate grapple for the world's industrial supremacy. Thus cast iron is being studied more than ever, its strength is being raised by changes and improvements in processes, and there is on the market to-day a range of irons from the brittle sash weights, which utilize all that would be dangerous in important work, up to the finest gun metals, and those irons which approach the regular steel castings in many ways.

Very little need be said about the history of cast iron. As a matter of fact the rate of progress in our days is so great that we can hardly pause to look back, being fully occupied to keep at least abreast of the times if we are not fortunate enough to be in the lead. Suffice it to say that the earliest attempts to cast iron as such were made in England and date back to the 14th century. As the value of everything in those days hinged upon its availability as an instrument of active warfare, we naturally read of the casting of cannon regularly two hundred years later. Our own Carnegie Museum contains two very interesting relics of cast iron made in the days of William Penn. From England the art of casting iron spread over the continent and finally came to America.

Until recently but little attention was given to the general run of foundry work. Iron was very expensive and requirements were not at all severe, specifications being practically unknown. To-day this is different. Competition has put everyone on the alert, every point is noticed and the small economies practised for centuries in the old country are now being thought more of here since the rich cream has disappeared from what was formerly a happy-go-lucky business. To-day we are on the threshold of a more rational system of working, our practical men giving their best efforts to improve molding and casting methods, while the scientific end of the trade is making the production of castings a distinct branch of the metallurgy of iron.

According to our general understanding cast iron is that form of iron which contains more than 1½% carbon and from its nature can only be cast into molds to be of commercial value. A closer examination shows us some limitations to this definition. A thin bar of ordinary cast iron can under suitable conditions be heated in the forge and then twisted, thus showing a property at variance with our intuitive feeling of what cast iron should do. Again, many street railway gears are sold as steel because the teeth can stand considerable punishment before breaking, and yet the iron is only an excellent grade of gun metal which has received the additional benefit of some annealing.

Cast iron in its true sense is, therefore, best classed as that grade of iron carrying over 1½% carbon, which after casting is not subjected to further heat treatment. Thus pig iron is a true cast iron, for the metal as it comes from the blast furnace, if of the proper composition, could be used for the direct casting of certain kinds of work such as ingot molds. Malleable cast iron, however, is not a true cast iron, for though the casting process is used, the original refining and subsequent annealing, with its radical metallurgical changes, place this most interesting material in a separate class entirely distinct from both cast iron and cast steel.

We have a variety of cast irons, made by a number of processes. Thus the same metal melted in different ways produces differently constituted castings, with a consequent variation in commercial value. This will be seen more fully in the discussion of the processes.

To look first at the material the founder of cast iron must deal with, we find an astonishing variety, all of which are useful in their proper sphere. In general they are the pig irons and the scrap. The scrap may be classified into the foreign (so called because it is bought in the open market), and the gates, sprues, defective castings and the like made by the founder himself, the composition or quality of which he may be supposed to know. In the foreign scrap there are varieties and variations. We have heavy and light machinery scrap, car wheel, stove and miscellaneous scrap, burnt grate bars and the like. The designation usually gives a clue to the quality, which is supplemented by breaking and examining fractures, but taken all in all, without a thorough knowledge of the possibilities of the methods used in mixing and melting charges containing this material, disastrous results are very apt to occur. This is especially the case with the miscellaneous

scrap which may contain the remains of many a burnt out grate bar melted over again, material which should not be taken as a gift when making good work.

The pig irons may be looked upon from the following standpoints: Depending upon the fuel used to make them, they are cold or warm blast charcoal, anthracite, and coke. It would be infringing upon the subject of the blast furnace to go into a detailed discussion. Suffice it to say that anthracite irons are now a rarity and differ little from those made with coke. The charcoal irons are too expensive for use in anything except high class specialties.

The experience of the writer, so far as the relative value of coke and charcoal irons is concerned, runs about as follows: The cold blast charcoal iron is probably the finest variety made, and taking irons of identical composition for comparison the charcoal pig is undoubtedly the better, for the apparent reason that in its preparation the chances of oxidation and consequent weakness have been at a minimum. This point may be disputed, for there is too little known about the molecular constitution of both irons to be positive about any statement concerning them. The fact remains that if the additional safety derived by the proper use of charcoal iron counterbalances the increase in cost, it is to be preferred. To the credit of well-made coke iron be it said that this condition exists only in special lines of work.

The second way of classifying pig irons is one rapidly getting out of date, and that is by their fracture. Anyone familiar with the variations in fracture produced by higher or lower casting temperatures would be little inclined to buy iron on this basis. Long experience and familiarity with the iron may give an inkling as to the quality of the metal, just as a steel expert can detect much of value from the fracture of a broken forging, but pig iron must be remelted, and many of its characteristic points seen in the fracture disappear in the casting made from it.

The commercial grades of soft, medium and hard, No. 1 to 6; the special grades of foundry, forge, silvery, and mottled irons, as analyzed by a chemist in the shape of a laborer with a sledge, are being gradually merged into plain pig iron carrying so much silicon, sulphur, phosphorus, manganese, and total carbon.

The range of pig irons, therefore, with which we deal to-day, are either high, medium or low in their constituents other than the iron. For current use it is still convenient to speak of "Bessemer" iron, which for the foundry means phosphorus below 1%, low sulphur and medium to high silicon; "softeners," which mean silicon between 4 and 8%; and "ferrosilicon," which means 8% silicon and above.

The foundry pig irons proper give us the choice between the following compositions: Phosphorus from .07 to 2.00%; silicon .14 to 3.25%; sulphur; .02 to .15%; manganese .30 to 2.00%, and total carbon from 2.50 to 4.50%, the proportion of graphite and combined carbon going to make it up, depending entirely upon the heat conditions and the amount of silicon, sulphur, manganese and phosphorus, —important in the order named—which may be present. One can readily see that with the limits above given there may be an endless series of combinations, and when it is remembered that to be able to predict successful results as required nowadays, as well as to obtain them, close attention must be given to this matter, and the lot of that founder who does not believe in chemistry or rather metallurgy in his works will eventually become a hard one.

We come now to the processes for making cast iron. For the production of castings on a commercial scale there are practically only two: melting in the cupola or shaft furnace, and melting in some form of the reverberatory furnace. The use of crucibles for melting may still be found in experimental work and possibly in some remote corners of the earth where civilization has not yet given the inhabitants the means of scraping together more dollars in a given time by legitimate means. Yet this crucible process is the one calculated to give the cleanest iron. We see this by analogy with crucible steel. The open hearth process can make a material exactly like that from the crucible in composition, yet the latter is so much better on account of its freedom from slag and oxidation. The chemical processes have more time, and the last traces of slag rise to the top.

In the reverberatory furnace, often called the straight draft, we have first the melting down of the charge, the rabbling or poling to mix it well and possibly help to clean it, and the slight refining called for by the work or else unavoidable while getting the proper casting temperature. It may be taken as a safe rule to let this refining action be as

limited as possible, for the change is internal, it burns out the manganese and silicon in the interior of the bath, distributes finely divided slag, and makes dirty iron if sufficient time is not given after tapping to let it clear itself; at best an uncertain proceeding.

To look at the matter more closely we find first in the charging the cause of much subsequent trouble. Where the furnace can be charged while hot, that is, where the scrap is no larger than can be gotten through the ordinary sized doors, it is comparatively easy to arrange melts so that the material easiest melted goes in first and forms a bath for the protection of that charged thereafter. The small scrap would therefore go in first and the pig iron last. To help matters, in case the iron is cleaned before charging slag may be thrown in which when melted forms a protecting coating on the iron and thus partly arrests the refining action of the oxygen passing over it. This coating of slag, however, is by no means a complete protection, for the internal action keeps the bath in motion, fresh particles of iron become exposed through the slag, manganese and silicon are burned out, which uniting with the oxidized iron form slag. If the temperature is high even carbon will go.

Thus it will be seen that there will always be more or less oxidation, with all the troubles that follow, from the very nature of the process, and founders of heavy castings which must be absolutely free from the surface blemishes caused by gases in the iron find this very oxidation one of their worst enemies. The logical conclusion would be to melt as fast as can be done without overheating the charge, and when the iron is properly melted and hot enough to cast let no delay keep it in the furnace subject to the oxidizing influences of the flame. When heavy scrap is to be used and the end of a cold furnace is taken out for the purpose of charging, one can readily see that the troubles of the founder are aggravating if anything, for the time of melting down a given weight is doubled or trebled.

So much can be said of the behavior of cast iron in the reverberatory furnace. The fact that the metal does not come in direct contact with the fuel (in the crucible method not even with the flame), keeps the product purer and hence makes the metal (when good) of high grade in spite of the unavoidable slight oxidation. Another factor in the comparison of cast iron made in this way with that made in the cupola is the molecular constitution of the respective products. Here we know too little as yet, but this can be said, that a gun cast from refined air furnace iron is undoubtedly better than when cupola metal of exactly the same composition is used. In every-day parlance the last mentioned iron would be judged to be of a "closer" structure than the first, but what that would mean translated into the language of science remains as yet one of the mysteries of molecular physics.

In the cupola process of melting iron we have a direct contact of the metal with the fuel. Under proper conditions the oxidation of the iron itself should be less, for that which is unavoidable falls to the manganese first, this uniting with sulphur and protecting the silicon in some measure, the silicon going next. While, therefore, a cupola charge should contain about 15% more silicon than the castings wanted, when there are high manganese pig irons present, or many scrap car wheels, this loss in silicon may drop to 5% and even less. Carbon as a rule remains stationary and may even go up by absorption from the fuel, 4.00% being about the limit under ordinary conditions.

One of the principal sources of danger is the sulphur in the coke. Too much care cannot be given to keep this as low as possible, and many a casting which failed unaccountably may be found full of microscopic cracks due to the absorption of this sulphur by the iron passing over it, resulting in an effect well expressed by the current term, "red-shortness," were it steel instead of cast iron. The bulk of our castings are made by the cheap and convenient cupola method. It is still crude in spite of many attempts to use the surplus heat now lost. It will fall to the lot of another to go fully into the status of foundry practice, this much being given with the view of showing to what influences the iron in the castings we buy has been exposed before pouring. Much more could be said, but we must pass on to the next subject, which is the constitution of cast iron.

It is practically impossible to speak of the physical without taking into consideration the chemical properties of cast iron, and vice versa. A casting freshly broken may be either gray, white, in a condition running between the two called "mottled," or it may be gray in the center then mottled and finally white at the edges. Again the fracture may show a distinct line separating a gray center

from the white chilled rim as in car wheels and chilled rolls. All of these conditions, whether produced naturally or otherwise, are dependent upon the composition and the thermal changes.

Then we have the crystalline structure similarly affected. Thus the crystals at the edge of a casting are usually small, and in the harder irons may be seen arranged in layers perpendicular to the surface, causing planes of weakness at abrupt changes in direction on the part of the piece. The interior of the casting, if thick, has larger crystals and is consequently weaker than the skin. This holds true only if the casting strains in the piece are not excessive, otherwise we may have the casting in a state of tension such that a comparatively small additional load causes it to give way, the true explanation for many a mysterious failure.

To get rid of such casting strains in the production of work to be finished up true, very heavy cuts must frequently be taken off. We are all familiar with the strains in pulley arms and rims, and it was the writer's good fortune, in a western mining region, to see an immense sheave for rope haulage which had just been taken out of the foundry to clean up, break at the junction of those spokes with the rim, where the heat of the sun shining on part of the wheel had added the very slight tension necessary to cause the wreck.

Where irons are cast into chills these casting strains are increased enormously, as for instance in making chilled rolls. We have here a thick shell of chilled iron contracting upon a gray interior. The ends of the rolls being smaller in diameter than the body, a period will be reached in the cooling when they solidify, leaving the interior of the roll still plastic if not fluid. The amount of contraction of a white iron from casting to coldness is about 1-4 inch to the foot, while gray varieties show up only half as much, hence we have an enormous pressure exerted upon the interior of such a roll which, according to discoveries made in subjecting small bodies of high carbon cast irons to such pressures, should make it a genuine mine for microscopic diamonds.

In looking at the structure of cast iron as it appears to the eye we have its color run from white to very dark gray. This is a question of the condition of the carbon present. For simplicity we will say that in white iron the carbon is all combined with the iron in some way, in gray iron it is nearly all mechanically mixed with it, and it may be mixed and combined in varying proportions in the irons between the dead white and the extra dark gray. The reason for such an appearance may be looked for in the resultant of three variable conditions, the composition, the casting temperature, and the rate of cooling. As to composition, silicon is the most powerful element acting upon the carbon. Its absence keeps the carbon all in the combined state. As it enters into the composition the tendency on the part of the carbon is to separate out as graphite, this going on until at nearly 4% of silicon the reverse takes place, the iron becoming whiter, though of a different crystalline structure and color, giving the "silvery" appearance to re-melted softeners and ferrosilicons. In these high ranges the property of silicon to replace carbon to some extent gives us lower carbon irons.

As before stated, sulphur, manganese and phosphorus have the same tendency to promote the formation of combined carbon, though in a smaller measure. The physical structures are also different from those produced by silicon, notably the difference in the chill line and in the crystallization of the chilled iron due to high or low sulphur with the same low silicon. The casting temperature is of great importance in this connection, the general rule being laid down that the hotter the iron the greater the liklihood to attain a whiter fracture. Thus one iron may be white if cast very hot and gray if cast colder. The rate of cooling comes in here, the thicker the piece the slower it will cool, so that if a wedge were cast of hot iron the thin edge might be white and the thick end gray.

One can readily perceive what a delicate matter it sometimes becomes in casting very heavy work with great variations in the thickness of the sections, to so combine the irons that a composition is obtained which when hot enough to properly run into the thin webs and ribs will not become white or at least not hard enough to cause undue contraction and make machining impossible. The fact that the physical condition of a casting is a resultant of these three variables is often lost sight of by those who write papers and are familiar with the laboratory end of the foundry only. Too much stress cannot be laid upon the absolute necessity of being fully equipped with a practical know-

ledge of the essentials of founding iron before venturing to advise others upon its metallurgical end.

If we look closely into the character of the various forms of cast iron as revealed by their microstructure, we find that in the gray irons a polished and etched surface is filled with thin veins of graphite. These are especially distinct when the etching is heavy, and show us that between the crystalline groups of iron there are thin lamellae of this very weak material. The rupture of a piece of gray iron is therefore along these planes of weakness, and the thin plates of graphite covering the iron crystals hide them from view. A thorough application of the scratch brush will quickly change a gray iron fracture to a white one, though the structure, unlike a genuine white iron, is coarsely crystalline. The application of acids for etching and very weak solutions of chemicals which color the iron and its carbides differently show, moreover, that surrounding these planes of graphite are carbides of iron from which it was evidently frozen out.

The heavy etching necessary to study samples of gray iron makes it difficult to see much, in fact in the study of steel and iron microscopists deplore the lack of illumination which would allow them to use their highest powers. Here is a problem for the physicist, to furnish a method of illumination something on the principle of the megaphone in sound. Microscopic investigation on iron and steel requires a vertical reflected illumination, as the specimens cannot be made translucent, and oblique reflection promotes incorrect ideas. Can light be so intensified, without undue heating, that we can apply objectives and eye pieces giving us an enlargement of 9,000 diameters instead of only 1,000 attainable at present, with any degree of confidence in the results? Could science only reveal to us a method by which we can see the molecule, what a wonderful stride this would be.

The appearance of the white irons under the microscope is quite complex, the high percentage of carbon in solution obliterating many of the characteristic forms seen in steels. Much is still to be done in this line, and the comparatively high percentages of the various impurities in cast iron should make this an interesting field. One thing is patent, and that is the extreme lack of homogeneity in cast iron. One might say that we have nearly pure iron, iron saturated with carbon in the shape of several carbides, iron saturated with sulphur, with phosphorus, possibly alloyed with manganese and carbon or with manganese and phosphorus, iron with silicon, and so on; all these mixed up in a heterogeneous fashion though with some pretense of arrangement based upon their relative freezing points, and the rate of cooling fixed by the thickness of the casting and the nature of the mold.

To this comes the additional complication in the existence of all the constituents in two or more forms. Thus phosphorus is present in two very distinct forms in steel, where they can be readily separated by chemical means, and give very different properties as the one or the other predominates. In cast iron, where the phosphorus contents may be up to twenty times the Bessemer limit, one can readily look for puzzling conditions. Again, the positions of these deleterious ingredients have their effects, more especially the sulphides present. Sulphide of iron is weak and brittle. It does not diffuse evenly but rather localizes itself. This may be the cause of some good now and then, for a high sulphur casting is very dense and impervious to gases, though it is not too strong. It would seem that in the contraction after casting the sulphide of iron, which has a low melting point, is forced inward by the outer shell which is setting. This can readily occur if the casting is thick enough, and in fact may save it from destruction, as the giving way of the fluid sulphide eases up the casting strains considerably. In view of the diffusive properties of some sulphides of iron this otherwise highly objectionable impurity may have some use after all. If the veins of sulphide of iron present run along the line of stress applied to the casting in service, its presence will not be noticed specially, but if across it, then a real danger exists. Unless, therefore, special effects are desired, as in ammonia, air and hydraulic cylinders, sulphur had better be conspicuous by its absence.

Cast iron is subject to two further troubles which have a distinct bearing upon its general behavior. They are segregation and shrinkage. In the first we meet a state of affairs perhaps a little more aggravated than in steel, for the rate of setting of heavy bodies of cast iron is slower, and consequently more opportunity is given to the impurities to segregate and therefore impair the casting. Thus the total carbon in the center of a cast-

ing may occasionally be less than in the surface, while manganese and especially phosphorus may be segregated in very large quantities. Indeed, the separating out of graphite in cooling is really a segregation.

As the fluid iron sets it first expands and fills the mold, then as it cools it contracts, the net result being a slightly smaller volumnar space occupied in the mold. As a direct result from this contraction the liquid iron is drawn to the setting surfaces, and more fluid metal must be fed in until the whole mass is solid. Should for any reason the supply of fluid metal be cut off, as for instance a thin section in setting cutting off access to a thicker one, there are bound to be unsound spots, called shrinkages, with consequent dangerous conditions. The very fact that they are seldom observed on the surface, unless indeed so bad that this dishes in makes the testing of all castings calculated to resist the penetration of water or gases absolutely necessary.

These shrinkage spots are sometimes very beautiful, being lined with a glittering array of many colored pine tree crystals grouped about in most phantastic figures. Necessarily white irons, with their great contraction and quick rate of setting, are especially subject to this difficulty, and special means must be resorted to to palliate, if not correct, the evil. The usual way is the application of a chill to the spots most likely to suffer.

We must therefore distinguish between the shrinkage in a casting, which is internal, and its contraction, erroneously called shrinkage also, which is external, and is allowed for in the pattern. There are some points in this matter which require further study. As a casting cools, the graphite already having separated out, there is a change in the carbon remaining combined comparable to recalescence in steel. Whether this causes further marked disturbances in the size of the casting is a much mooted question, evidence on both sides being in. It has appeared to the writer that the apparatus used by all those who have experimented in this line was too crude for the delicate observations which must necessarily be conducted. He therefore recommends the use of mirrors arranged to move with the cooling metal, and rays of light reflected from them upon bromide paper moving at a given rate of speed. This, if properly carried out, should give a sufficient enlargement without any friction of moving parts, or absorption of minute movements in the mass of the apparatus.

A further difficulty to which many a failure to obtain sound castings may be laid is the presence of gas in the iron. This manifests itself by coming out at the moment the metal sets. If it can get away through the mold, well and good; if not a smooth walled aggravating hole just under the skin, and often defying detection, is the result. The trouble may be laid to the handling of the furnace or cupola, the use of burnt material, and probably what is least suspected, the tendency of late years to produce pig irons too fast with the resulting liability of oxidizing them slightly.

The peculiar shrinkages in iron are closely related to the heat conditions they have been subjected to, this bringing up the questions of fluidity, melting and casting temperatures. In general we may say that the hotter the melted iron the greater its fluidity (and incidentally the shrinkage); that is to say, if an iron which melts at 2,200° F. is heated up to 2,400° before pouring, it will be more fluid than if only 2,250°, and consequently be likely to properly fill up very thin sections. Our common experience is that the higher the carbon, silicon, manganese, and especially phosphorus, the greater the fluidity of the iron. Sulphur acts the other way. Moreover dissolved oxygen, which means burnt iron, takes all the life out of the melt, makes it thick in the ladle, and gives rise to misruns, dirty and spongy castings.

It is an open question still why white irons chill so rapidly, making it necessary to lose no time in pouring after tapping, while the gray irons can be transported for miles from blast furnace to converter, or held in ladles pending the ordinary delays incidental to daily work. True the melting point of white iron is lower than the gray, but there should be about the same rate of cooling in both unless—and this is quite likely—there are chemical reasons to hasten the congealing of the white varieties.

The one point which must not be forgotten here is this: After an iron is brought up to its melting point, it takes further heating to melt it, a situation parallel to making water from ice. Thus a white iron must be raised to about 2,100° F. and then requires one-tenth of the number of heat units consumed in doing this in addition to melt it. With the gray irons, which melt at only 150° F. higher, there are more heat units made lat-

ent, the total amount for them being about 10% higher. Aside from chemical conditions and a possibility that the freezing point of each class of iron varies somewhat from the melting temperature (matters on which we have no information as yet), this circumstance may help to account for the remarkable length of time a gray iron may be kept fluid; for all this latent heat must be given out before it sets.

As to the melting point of cast iron, it was the good fortune of the writer to contribute a series of observations on a wide range of white and gray irons only last month, thus corroborating by actual trial the daily experience of observant foundrymen. The set of 57 pig and cast irons, with but few exceptions, had no abnormally large variations from ordinary standards, but the range of silicons from .14 up to 3.29%, with their corresponding variations in combined and graphitic carbons, were admirably adapted to bring out the influence of the former to lower the melting point. The two extremes only are given herewith: a white iron which melted at 1,990° F. having 4.20% combined carbon, and a gray one going at 2,280° F., or 290° higher, contained only .13, the balance of the 3.56% total carbon being graphite. To properly determine the influence of phosphorus, manganese and sulphur on the melting point it would be well to take an iron which remains perfectly white at all casting temperatures, and add to it different proportions of these elements while it is in a melted state, casting each resulting mixture at once. In this way, all the carbon remaining combined, a good comparison would be obtainable.

In connection with the molecular structure of cast iron its specific gravity is of some interest. The whiter the iron the higher this will be, for not only does the space occupied by graphite in the gray irons decrease their density, but the very fact that they are gray, when cast under normal conditions, indicates that they may contain up to 3.25 per cent of silicon. Thus the specific gravity of white iron is given as 7.6 and that of gray as 7.0. This difference has its influence in practice, for it is customary and convenient to simply weigh the pine pattern and multiply by 16 to get the weight of iron required to pour the casting. While this does very well for ordinary gray iron casting, the white varieties require a higher factor.

In a number of determinations made by the writer on the specific gravity of cast irons, the upper limit given above was extended a little, results as high as 7.8 being found where a white iron had been cast into chills. Gray irons which were chilled had the specific gravities raised 0.3 above their normal figure, thus showing the difference in density brought about by a change in carbons from graphitic to combined.

The purpose for which a casting is to be used naturally has, or should have, a deciding influence upon the kind of irons selected for making it. The days when anything went have passed and the result has been a very discriminating specialization of the work. In a jobbing foundry this may be taken care of to some extent by suitably mixing the charges in the cupola, but in general we find the best results obtained in shops arranged with their special ends kept constantly in view.

Here are a few varieties which show the flexibility of the general appelation, cast iron: Heavy and light machinery castings; stove plate; cylinders, light and heavy for air, ammonia, or steam; brake shoes; car wheels, which have gray centers and chilled rims; similarly chilled rolls; sand rolls, that is, rolls not chilled on their surface; gun metal, which is made in the reverberatory furnace and embraces a variety of sub-divisions; dynamo frame castings, in which magnetic properties are essential; ornamental castings, from radiators to imitation suits of armor, plaques, and even the exact reproduction of insects used as a pattern; pipe fittings; novelty work; hardware and agricultural machinery castings; pipe, plows, with their chilled points; ingot molds; sash weights, the scavengers of the junk piles, etc.

All these materials are produced for the purposes indicated in the classification just outlined, by a proper adjustment of the silicon, phosphorus, manganese, and sulpaur contents within the range indicated in the early part of this paper, and coupled with physical manipulations characteristic to foundry practice. Fortunately, where extreme ornamentation is desired strength is no special object, and vice versa. There are, however, sometimes requirements specified which puzzle the foundryman not a little, for instance, where great strength is to be combined with ease in machining, amounting to

practically an iron which is at the same time hard and soft. Naturally in this instance a sufficient amount of steel scrap is added to give strength by the reduction of the total carbon, and the silicon is kept up high enough to throw as much of the carbon present in the graphitic state as possible.

The strength of the iron is dependent upon its composition and the physical treatment received until a finished casting. Even afterward the service conditions have a deteriorating effect but little estimated, in fact, a value almost unknown as yet. Cast iron having for practical purposes no elastic limit, the actual breaking tests are better calculated to represent service conditions than is the case for all the other forms of iron. The strength of cast iron as shown by physical tests ranges between very wide limits. Not only will the different kinds of cast iron run far apart, but actually the same iron when cast into various sections shows a distressing lack of homogeneity, which makes comparisons the merest guess work. What methods of testing to adopt, what test pieces to use, etc., is now occupying the attention of several national bodies of men interested in industrial progress, both here and abroad, and the outcome, it is hoped, will be of much benefit to the manufacturers and consumers of iron castings.

The tensile test is one very difficult to apply properly, but gives sufficiently high values to allow a differentiation, having a given size and shape of bar cast under as nearly the same conditions as possible. The tensile strength of cast iron may run from 14,000 up to 35,000 pounds per square inch, the former being found in soft but bulky castings, and the latter in the highest grade of gun metal strengthened with the addition of steel scrap. Here we see the effect of lowering the carbon in the casting, the strength as a consequence going up. High silicon lowers the strength; phosphorus, when not over 0.5 per cent, which is the safe foundry limit, rather stiffens the iron, makes it pull stronger, but leaves it brittle. Ordinarily castings should run between 17,000 and 20,000 pounds per square inch tensile strength.

The modulus of elasticity of cast iron varies from 10,000,000 to 30,000,000, showing the utter lack of value of tests made on cast iron unless all the conditions existing at the time are taken into consideration, and preferably all the outside influences affecting the results removed as much as possible. Again, a set of bars of the same cross section, but of regularly increasing length, when tested showed a regularly decreasing tensile strength, the last actually being one-half as strong as the first. Results of this kind shake one's faith in all tests on cast iron, but this very circumstance makes it all the more important to dive deeper into these mysteries and get more light and those rewards always coming (usually to the other man, however), from patient investigation and study.

The transverse test of cast iron is the easiest to carry out, and with the same cross section, same distance between supports and the identical method of testing, the records are in some measure comparable. Yet it is idle to wade through elaborate tables giving the modulus of rupture of cast iron calculated to the square inch, when we know that the same iron in bars of the same section, when tested with varying distances between supports, gives hopelessly discordant values when the regulation formulae are applied. No wonder that the modulus of rupture per square inch for cast iron thus calculated varies from 10,000 to 65,000 lbs. In making transverse tests the load applied to produce rupture as well as the deflection should be noted. Here, also, we have the effect of a moderate amount of phosphorus showing itself in an increased strength and amount of deflection, but it will be noted that this is the case only with a very gradually applied and slowly increasing load, for the slightest shock means an instant break.

The crushing strength of cast iron is, so to say, its strongest point. It varies from 40,000 to 200,000 lbs. per square inch. This test is seldom made, for if the iron is sufficiently strong to come up to all the other requirements, that of resistance to crushing is almost superfluous. Nevertheless, for certain classes of work such as rolls and hammer dies, much could be learned in this way, especially when combined with heat conditions.

Impact tests on cast iron are almost unknown, but could be made with considerable profit, even though objections have been made on the ground that cast iron is never exposed to shock while in service. Once efficient machinery for this method of testing is provided, we shall hear more of

it. We now have some vague ideas of the resistance of cast iron to shock from resilience calculations made of bending tests, but these results are empirical and need further extension and study.

A test for the hardness of cast iron would be a desirable addition to our list, and several ingenious methods have been brought out for this purpose. They will fail to be adopted generally, for we again strike the lack of homogeneity in cast iron which will leave the skin harder than the interior and the cooler portion of the iron while casting softer than the hotter immediately at the gate. The methods of testing hardness commercially will, therefore, remain a local application, each shop requiring such a test getting up its own modification. Careful regulation of the mixtures and casting temperatures should go a great way to make this style of test only desirable in special cases.

There are other tests, such as punching and shearing, for fluidity, contraction, chill, behavior under heat, etc. This much can be said, that the testing of cast iron is in so crude state as yet that formulating elaborate specifications to cover anything but the most general points is often a positive injustice to the founder, and moreover, a retardation of progress toward an international agreement on standard methods of testing.

The writer has not dwelt much upon the effects of the various constituents of cast iron when present in large quantities, deeming this subject rather overwritten of late. He begs the indulgence of his audience for any shortcomings in this hasty sketch of a widely diversified but highly interesting branch of the vast iron industry.

Useful Foundry Hints.

By R. D. MOORE

POURING.

In pouring a cog-wheel or other casting difficult to cast perfect, that is, without "cold shuts," as in the teeth of a small wheel, for example, if two or more ladles are used, and, as is often the case, some ladles much colder than others, being over iron from a crane ladle, the hottest ladles should invariably be poured first, as the first metal poured forms the extreme points, the cogs in a wheel, for example, which every molder knows is the most difficult part of a cog wheel to cast free from cold shut blemishes.

ANOTHER ADVANTAGE.

A cog wheel gets another considerable advantage in strength by having very cold iron poured last, to form the hub and center; the superior strength thus obtained arises from the greater equality in the time of cooling off, leaving less shrinkage strain resting on the casting.

The error of pouring the coldest iron first appears to be almost universal among molders, and has been the means of spoiling many an otherwise good casting. That practice is, no doubt, prompted by the laudable desire to get the cold iron out of the ladle, but overlooks the more important interest in the casting. I once witnessed such an error by a "money making" foreman.

I once had a rare opportunity to experiment in this connection. A rolling mill boss ordered a pinion, weighing about 550 pounds, to work in a pit that generally contained water, which made the teeth wear rapidly, and asked, with a knowing smile, if we could make the teeth very hard and the hub soft. I astonished him, after casting a glance at the furnaces, by replying that I believed we could, for that day only.

We were casting a Louisiana sugar mill roll that day, weighing about three tons, melted in an air furnace. The metal was highly mottled in the 3½ to 4 inches thickness of metal in the roll, which promised that the pinion teeth would be white.

We charged 300 pounds extra and kept it in the furnace, after the roll tap, until the soft was melted, when 300 pounds of each was tapped in four shanks, pouring the hard first. The hub was formed soft enough for tooling and the teeth white.

The result in this experiment goes a long way toward settling the question about the hot iron leading, in pouring a pinion at least. It proves that the first iron finds its way, almost entirely, into the rim, where the hottest is needed.

THE POSITION CONSIDERED.

The speed required in pouring castings does not depend entirely on the extent or thinness of the casting, but very much upon the position when poured. An engine or lathe bed, which is usually formed mainly of thin plates set edgewise; a street pipe, cast upright; a pulley rim, or a cannon stove, are all instances in point; they can all be poured much slower than plates of the same extent and thickness if cast level.

A steam chest lid weighing 100 pounds requires much more rapid pouring than a piston packing ring of the same weight and thickness. Doubtless the true theory is that the fluid iron in filling a mold must rise at a certain speed, according to its temperature or fluidity at the moment, to prevent setting or "cold shutting." In the lid plate we have a rise of less than two inches during the flow of the 100 pounds of iron, whereas, in the packing ring we find a rise in the metal of 7 or 8 inches during the pour, which accounts for the difference in the speed required.

A bevel wheel, other conditions being equal, requires fast pouring, just in proportion as the rim lies flat or horizontally, this difference being generally overlooked.

A bevel wheel with a very flat rim will probably require a pour three times as fast as a mitre, an average bevel.

A pipe cast horizontally cold shuts easiest on a level with the top of the core where the sheet of metal spreads to its greatest width, and consequently its slowest rise.

The point hinted at on the effect of position, in maknig a pour, will be found to run entirely through the casting handicraft, making more clear and interesting some of the practices we are familiar with.

A stove plate is a good sample of a strictly horizontal casting, and the speed required in the pour is simply immense; and nothing but a flat gate would accomplish it so easily.

When an apprentice, I helped to make the plates that formed the ceiling for the portico of the Girard College. They were about 6 feet wide, 18 or 20 feet long, ⅞ inches thick, with a 4-inch stiffening rib on each side, and the same around the center panel opening, a very large plate for those days. They were poured with two crane ladles, very fast as we estimated the first day, but it was too slow. That lesson was enough; we never failed again while filling that long contract.

Foundry Equipment.

BY SETU WRIGHT.

After years of traveling and study of the foundry, I am convinced that the only way to be successful in competition is to equip your foundry with everything possible to simplify the production of the work for the molder, thereby increasing the product, for a molder can only work just so fast, to secure good results every day, and with a poorly equipped shop in competition with a more modern foundry the chances of success are very slim. Taking work at prices that the modern foundry would not touch, you have to get hold of a foreman that has lost his manhood in demanding exorbitant tasks from his men to secure the amount demanded of him by his managers, when they will not produce the necessary equipment to obtain good results, and the men are in such a condition that they do not care whether their work is good or bad, as their spirit is driven out of them, making their task a severe burden. I have worked in such shops and have studied the results. Now if poorly equipped foundries would set themselves to work at once and first study the above, and then take their percentage of bad castings for the last twelve months and will improve the facilities in the foundry by the expenditure of the amount lost, they will be amazed in the change both in production and saving of work.

Now take a jobbing shop, where they would say, "We could not afford to have flasks and boards for each job, as we are continually changing our work." It is not necessary. Take, commencing at 12"x12" and proceed making flasks up to 6'x6', with cheeks at depths from 4" to 12", having all flasks flanged at joints, thereby enabling you to make a flask as deep as required, with plates for bottom-boards; also supply each molder with a complete set of tools supplied by the firm, and an abundance of gaggers and rods, preventing the usual walking up and down the shop looking for things to work with. When fitted out thus it is not necessary to have a skillful molder making this or that difficult piece. Where the method of bedding in is adopted, and you have only three or four men for such jobs, sometimes having to wait on them to get your work made or else put some less experienced man on the job and try him anyway, and have the scrap heap fattened for the result of the experiment, whereas if you had been equipped that same inexperienced man could have made the piece from 25 to 50 per cent quicker and gotten a good casting with less labor, and at the same time enabling you to meet the competition of the present times.

I suppose some foundryman will read this and finish up by saying to himself, "I have not the money to expend on equipment, or even improvement." I would say to him,

make one flask and keep a correct record of the work produced in it, and he will find at the end of one month that he has paid for the cost of producing the flask, and he still has it, and he could keep on improving in that manner until he had made money enough to equip the whole plant, and then he is in a way to have that which kept him from improving at first, for deferring the day of improving his plant is a sure way to destruction in the foundry business, as we are now in an age of keen competition, with prices a little lower than "Grandpa" used to get.

I know of a large foundry in the unequipped condition which had a casting to make that weighed 14,000 pounds. They used an old wooden cope to cover it after bedding in the pattern in the floor, and they lost two and secured the third with a very narrow margin on the right side of nearly losing it, all through the cope, and still they have the old "jonah" to use again if the same job comes in. Now the cost in this case was considerable. Two molders took three days with two helpers, wages $50; loss in melting the iron for the two bad ones, 2,000 pounds, $10; loss in breaking up with the ball, $10; total loss, $70. Now take flasks wanted in that shop, as is the case in many others, and for $70 a foundryman could make a nice collection, as he only loses the cost of labor to produce them and a small loss in melting the iron required.

I could go on to some extent, but will defer this time, hoping this little article may be the result of good fruits to many unequipped foundries in the coming year.

Casting Sash Weights.

The other day I strolled into a foundry in this city and found them making sash weights, but not in the same old way. They were making them in chills. That of itself is not very strange, but the appliances they used were novel. The chills were made in two sections with hinges, and each contained molds for two sash weights. The chills are vertical, the inside one is fixed and the outside one turns on its hinges. There are two rows of about twelve in each row, and these they call a battery. Between the two rows is a 2-inch water pipe connected to the bottom of each chill by a half-inch pipe. Above the 2-inch pipe, and between the chills, runs a trough, or gutter, to carry away the water after it has run through the chills. The chills are made hollow; that is, they are cored to form a water space. This core is about 1 inch thick, with a division in the center to strengthen the chill. The chills are about 18 inches long and 4 inches wide; that will leave about 1 1-2 inch thickness of metal. They will last from eighteen months to three years with fair usage.

They were about to pour when I went in, so I thought I would stop and see the performance, and they have things down very fine. There were eight rows of chills, or four batteries; each battery had a runway over it, extending to the cupola. There were four men to attend each battery. Two of these men took the ladle to the cupola and filled it, then lifted it up on the bail that was on the tramway and brought it over the molds. In the meantime the water had been turned on, and water was all around, so that it looked quite dangerous to be there; but everything went all right. Of course, there was a little iron spilled, but it did not make any rumpus. I forgot to say that molds were poured on the top of the chill, through a bell-mouthed hole. When about three were poured a man came along, lifted up the one handle that served as a clamp, opened the chills, gave a slight blow to the tops of the runners, and the castings fell out on a hook that he had in his left hand; then he threw them down and went on to the next. After him came a boy with some dope, which he placed under where the iron dropped, to save the chills from cutting away in that place. After him came a man who closed the chills again, and then they were ready for more iron. The operation takes a deal less time to do it than it takes me to write it. They start to pour about 12:30 and keep on till about 5 p. m. Their usual output is 20 tons per day, 5 tons for each battery.—Thomas Wathey in American Machinist.

A Chat With Apprentice Boys.

BY R. H. PALMER.

THE FOUNDRY has been a welcome visitor to all of its readers for some years past, and among those readers are some apprentice boys, and I want to talk with them a while. I am glad at nearly any time to see one, if I cannot then talk with him.

The thinking boy who reads THE FOUNDRY knows how to keep his eyes open, and when he sees something new to him, he

catches it, and he is welcome to ask questions, provided he takes the proper time to do so.

I remember going into a foundry where they made different work from what I had been accustomed to seeing, and of asking a few questions, and being told, "Experience would have to teach me." Since that time, experience has taught us both. We have much to learn.

Now, boys, as memory goes back to the day I entered a foundry as an apprentice, and as the practical jokes played on me, by men, who in after years were firm friends (and some of them will read this), and remember how they helped along my initiation, rise before me, I can imagine some of you going through the same routine, and getting the same good advice that was given me. We are all human, and experience will teach us many things we do not wish to know, for if there is a wrong way to do a thing, we are oftentimes doing it before we realize the fact. Some of you remember how Tom played a joke on you, and you would have liked to punch his head.

Yet, did Tom show you an easier way to do some part of your work? Perhaps George caught you napping, and started you around the shop after a half round square, yet when you are put on helping George, he let you finish a part of the mold; you had been mixing facing, straightening nails, making gaggers, etc. This was the first time you had taken a tool in your hand to finish any part of a mold. Of course you know it was not a very important part, but it was a part.

We will suppose you did the best you knew how, and that is all any of us can do. The consequence was, he found you were trying to do all you could, and the best you could. It dawned on him you might be good for something. He took an interest in you, he let you take another part, more important, with the same result. You finished it fairly well, as well as you knew how; you were learning the use of other tools on other parts, by watching him.

There was Bob, he had a bad drop or not a very clean lift; you saw he was behind, the wind was going on, and he was hurrying with all his might. You had your work done, and was getting the benefit of that breathing spell, between the time the wind goes on and the iron is ready to pour, which fits the molder for the heavy pouring off and hot shaking out, provided he has arranged his day's work aright. You saw Bob was in trouble, and went over, and did what you could to help him out, without being asked, or being told to do so; the result was that Tom, George and Bob had a good word for you.

Time passed on. You helped others when you could, your shopmates kept on with their jokes on you, and each other; your quick temper may have gotten you into trouble at times, and you found you must learn self-control. Before doing so, your shopmates had many a hearty laugh at your expense. When you saw other apprentices enter the shop you helped initiate them, and enjoyed their discomfiture as your shopmates had yours. You will not deny this. Yet by this time you knew the force of the axiom. "Help me, and I will help you." If we wish to receive, we must give—help.

You had helped, yourself; you had won the good opinion of your shopmates and made friends of them, and you had their best wishes. In gaining their's you had gained the foreman's; consequently, he was determined to give you a chance; you had been showing yourself worthy of it. Now, boys, I am not imagining an angel in a foundry, but many a foreman in reading this will think, "My Tom or Harry is that kind of a boy." A foreman's range of vision is larger at times than boys or men sometimes think. He remembers at times. Now came a time when those men who had played tricks on you remembered the times you had tried to help them, and finding you were ready to be guided by them they were bound you were not going to be stuck on a job. How many times has one of them come along, and seeing you were doing something wrong, he would stop and show you the right way? perhaps about gating, so that the casting would come clean, or a little heavier gate, as there was a possibility of its not running, or so that it would not wash a part of the mold, and lots of tricks of the trade. The foreman was watching; he could appreciate good work, and he saw you were striving to do a day's work, not striving to kill time and beat the company, and expecting him to wink at it. He had confidence in you to advance you as fast as he could. Were you gaining?

But stay! In some shops there is another boy, of a different kind (there are hobo molders and hobo apprentices). He enters the foundry as an apprentice, to be made a

molder of in three years, according to the machine shop's theory (in some places). He could not, and did not have brain enough to fit him to learn to run a lathe, while as to anything better it was out of the question, but he could pound sand. This required nothing but physical strength in some men's estimation. The idea of molders having brains! It was simply ridiculous! They had no use for them! It was the general idea of machine shop and draughting room. The foundry was the football of the two. To-day the two trades (or shall I say professions) have more respect for the thinking, intelligent, self-respecting molder, and it is owing to such papers as THE FOUNDRY and "American Machinist" and others giving place to the writings of Thos. D. West, R. D. Moore and others whose names would make a lengthy list, and last but not least, by the self-respecting molder.

Do you know what men think of such a boy? Listen to what they say: "He is naturally lazy"—"He does no more than he is actually obliged to"—"He does what he is ordered to do so far as he can without working too hard"—"He never anticipates a want"—"He has to be told over and over again on work that he is perfectly familiar with"—"If Bob or Tom is 'in the hole' he will let him stay there." If it occurs to him that he could help them out, he is too infernally lazy to do so. If a molder sends him on an errand, he moves so slow the man wishes he had gone himself.

It don't take you long to form your opinion of that shopmate, and in a short time the whole shop will be sour on him. When he skims a ladle, he is so careless he will let a part of the dirt slip by, or knock part of the lip off. The next thing, the molder don't want him for a helper, and says he's no good, and gives him little encouragement. It is the old saying, "Give a dog a bad name," etc. They feel they cannot trust him, and in the loss of confidence, there is the loss of work. Ask yourself. While on the other hand, they will ask for the other boy. Then, in the shop, there is some charitably inclined molder, who, taking pity on him, takes the boy with him. Does the boy appreciate it? No! The foreman would be doing the boy and others a favor if he told him he did not think he would be a successful molder; but instead (perhaps he is compelled) puts him in a corner of the shop making flat-backs. Finally, the boss's conscience gives an extra thump, and he gives him another chance. The boy has not kept his eyes open to see how others made the job. He asks a molder near him; 10 to 1 he hears, "Oh, you know it all; now make it." When he was given instructions by the foreman it went in at one ear and out of the other. He has not been obliging to those around him; and, if anything, they think he deserves the lesson. If any pitied him, and tried to show him, he "knew it all," as the molder had said.

Boys, appreciate a kindness. Not only say thank you, but mean it.

Another point: Keep your eyes open. It is not altogether what a man learns by experience in doing a thing himself; it is by seeing others, and profiting by their mistakes as well as good fortune. Don't go through the world with your eyes shut. If you do, you will shortly break your neck. You say, of course you would. Think it over, then, and don't let those opportunities slip by. Look out for the hat on the first of April, with a brick or stone in it. There are lots of April fool days in our lives. We know after we kick the hat. Then, boy, do you remember that casting we made that scabbed because we rammed it too hard, and did not vent as we ought? Besides, we got that facing a little too heavy. Remember how mad the old man was? He was in such a hurry for it, and they were rushed so. You know he asked us what was the matter with it; and we thought at first how we could get out of it. Of course we had learned that important part of the trade. A good molder always has a good excuse.

But I think we felt better for owning up that it was our carelessness, and trying to do better. More so, when we saw him go to that other fellow with, "Who gave you the cores for that casting?" "Coremaker." And in a short time you know he came back with "The coremaker says you went and took those cores, saying they were all right. Either tell the truth or get out."

When you are in the wrong, or make a mistake, own it. All men know the man who has never made a mistake in some form does not live, and they make allowances; but excuses don't always go. They make one sick, sometimes; and above that, don't try to put the blame on a fellow workman, especially if it belongs to you; don't lie. Remember, the truth will stand; a lie won't.

And if your foreman is one of the gentlemanly driving fellows who cannot bid you good morning without looking as if he wanted to add d——n you to it, and you must take a howling, he may have enough respect for you as being capable of telling the truth, so he will leave the d——n you off.

Now, how many years have gone by? Two. And we have seen the iron running from the cupola for the past two years and haven't thought much about it. Bob, how do they charge the cupola? Let's go over and see. They have just finished chipping her out. Getting down on our hands and knees we crawled under and stood up inside. Looks as if it needed patching above those holes. What is it they call them? "Tuyeres"?

"Get out of here," calls a voice. It was the melter, with his box of daubing. "You cubs will get your heads broken some day. You're all time nosing around to find out how things are done!"

That was my introduction to a cupola. I was driven away to-day, but was back to-morrow, or when I could get a chance. At that time, as far as I know, there was not a great many books on actual foundry practice. I mean the actual foundry work; and if there were, I knew not where to get them.

So I kept my eyes open, and asked lots of questions.

Now, boys, after reading my experience, if you wish to learn something more about the actual cupola practice, go to your foreman and ask him to put you up on the cupola. When a man sees that a boy really wishes to learn, it is seldom you find one who will refuse to do what he can for him.

In those days, plenty of men would laugh at the book-learned molder or melter. The same men to-day read THE FOUNDRY and like journals, and profit by it. So, my boy, you should not omit to do likewise. Also, read the works on founding by Thos. D. West, Simpson Bolland, Dr. Kirk, etc., etc.

Life is not so long that we shall be able to get all needed knowledge by our own personal experience, and we must get what we can from others.

The up-to-date molder finds it so, and remembers, the more you know the more salary you can command; also, the more pleasure for you in life. In these days, when heavier machinery is called for than ever before, you will be called to make heavier castings; consequently, more responsibility will rest on your shoulders.

Do you ever stop to think of what your carelessness may mean to your employer? A nut not properly tightened, a wedge not forced home, may cause a run-out and the loss of the casting.

But, you say, you are an apprentice. Certainly. Is that any reason why you are not accountable? If you finished the mold well, secure it well. Many a man has made and finished a mold well but lost it by not properly securing it. Your employer pays your wages, and he pays them in order to obtain castings that he can sell, not for the scrap. Remember it means to him success in business. To you what? Success in life; for you are learning a trade to obtain a living by; and how good a living, remains for you to determine.

Don't say, as one boy did to me, when I wished to put him on a different kind of work, "I will be satisfied if I am as good a molder as my uncle so-and-so," but strive to be a better man as a workman.

Have some ambition; devote some of your evenings to study. You say you are "so tired." True; and it is so much easier to go and have a good time, and spend the little you have to spend.

Look here! you boys that have good homes, and a father who wants his boy to be a good and successful man. Which is the easier, to devote some of your evenings to study, or to have to cut up other molder's sand heaps who are working by the piece, in order to get enough to clothe yourself, and then go to a libray to get your reading matter? Ask yourselves the question.

Boys, you have many opportunities to acquire knowledge. Look at the technical schools that have been established all over the country; and why? Because the founers have seen the necessity of giving you boys a chance to better fit yourselves for your future. Take advantage of them. You are not obliged to devote all your evenings; you can have time enough for play as well.

Acquire a thorough knowledge of mathematics, draughting and bookkeeping. See what you can learn of chemistry; and be sure and catch a good big dose of the swelled head, and I hope you will have it early. Like the measles, it won't be quite so hard to knock it out of you when you're young. Everyone has it, in all walks of life.

Do you remember when Tom told the boss he could make anything in the shop, and he gave him that big double bumper to make?

Do you remember how he came out on it? You have all lived long enough to find there are lots of bumpers in life.

Grit your teeth, spit on your hands and make up your mind, "I'll get there yet."

Among the Foundries.

The Hercules Pipe Foundry, of Anniston, Ala., will enlarge its plant.

The Bussey-McLeod stove foundry, Troy, N. Y., has closed for the season.

The force of the Michigan Malleable Iron Works, Delray, will be increased to 800 men January 1.

Marysville Machine Shop and Foundry, Marysville, Wash., made its first castings December 16.

The Superior Drill Shops, at Springfield, Ohio, have been transferred to the Pan-Handle road for $65,000.

E. Harvey has leased the Martin Iron Works, at Fitzgerald, Ga., and will operate a machine shop and foundry.

The Downing Foundry at Rock Island, Ill., has been sold to Messrs. Morris & Lewis, who held a chattel mortgage on it.

Girls make cores in the foundry at Kewanee, Ill. If this thing keeps going the boys will have to marry the girls or starve!

The Weston Engine Company's works, at Painted Post, N. Y., have been sold to the Rand Drill Company, of Tarrytown, N. Y.

The old Whitely malleable plant, at Springfield, Ohio, now owned by I. W. Fry, will start up this month (December) with 100 men.

W. T. Stackhouse, of Wilmington, Del., has purchased from James T. Power the Elkton Foundry, Elkton, Md., and will operate it.

The Buckeye Engine Co., salem, Ohio, is installing a new ten-ton traveling crane in the machine shop and a five-ton crane in the foundry.

The Worthington Pump Co., Elizabeth, N. J., is discharging men who have been gtting $5 and $6 per week and employing women at $4 and $5 per week, in the foundry.

J. S. Hughes and E. E. Wittenberg, formerly with the Atlas Engine Works, Indianapolis, Ind., have leased the Green Foundry, at Des Moines, Ia., and will operate it.

Mr. E. A. Keene, for the last two years in the foundry business at Livermore Fall, Me., has leased the old Plainfield foundry plant, Plainfield, Ct., and will operate it.

The American Steel Foundry Company, St. Louis, Mo., is enlarging its plant. The new casting building will have a center span of 80 feet, and wings of 60 feet, the total length being 400 feet.

The ore handlers at the Illinois Steel Co.'s South Chicago docks have received a 5 per cent increase in wages, and on December 24 will be given back pay at the advance, dating from early spring.

The Buckeye Engine Co., Salem, Ohio, has enlarged and greatly improved its plant. Among other features is a 10-ton traveling crane in the erecting room, and a 5-ton traveling crane in the foundry.

A burglar by the name of Charles Ross has been placed in the Harrison street police station, Chicago, who, among other achievements, stole $1,500 worth of goods from Louis Turivas' foundry, Chicago.

The Barney & Reed Manufacturing Co., a new Maine corporation, has purchased the old Alston Foundry, Alston, Mass., and will start up a general foundry business. The price named in the deed is $40,000.

The A. P. Wagner Tool Works Co., Detroit, is the name of a firm which has been removed from Sidney, Ohio. Capital stock, $150,000. The works are located on the Michigan Central railroad, Springwells.

The Baldwin Locomotive Co., Philadelphia, have just received an order for 56 locomotives, of which 16 are for the Imperial Railway of China. They are running the works day and night and putting on more men.

The Fowler Cycle Manufacturing Co., Chicago, through its assignee, has begun suit against the Whiteley Steel Co. and the Whitely Malleable Castings Co. of Muncie, Ind., for $50,000, for alleged violation of contract.

A mortgage of $1,500,000 from the Walker Mnfg. Co., Cleveland, O., to the Central Trust Co., of New York, was filed with the county recorder at Cleveland, on Saturday, Dec. 31. It is a second mortgage, and is to secure an issue of bonds.

Employes coming to their work, December 17th, at the office of the Sennett Foundry Co., Youngstown, Ohio, found the night watchman bound and gagged, and released

him. The job had been done by burglars, who escaped with about $28 in money.

The John S. Davis Sons foundry and threshing machine plant, Davenport, Ia., has been sold to a syndicate composed of Rock Island and Davenport capitalists, and will be under the management of L. J. S. Greene. They will manufacture hardware and implement specialties.

An injunction has been granted by Justice Chase of the Supreme Court, New York, to restrain members of trades unions from interfering in any way with the employes or the business of the West Side Foundry Co., of Watervliet, Wm. M. Sleicher and Wm. Sleicher, Jr., proprietors.

J. C. Buckley, for ten years past manager of the Ames bronze foundry, at Chicopee, Mass., has leased this, and also the Ames iron foundry, for one year, with the privilege of extending to ten years. He is adding men to his force, and expects to do an aggressive, thriving business.

The Addyston Pipe and Steel Co., Cincinnati, Ohio, have voted to increase their capital stock by $300,000 of cumulative 6 per cent preferred stock, for the purpose of building factories in Alabama. Ensley City and Bessemer have offered sites. The Southern product is intended for export trade.

The Whitney Car Wheel Works is the style of the new firm that has resumed operations in the plant known as A. Whitney & Sons, Philadelphia, Pa., with the following officers: Jas. S. Whitney manager, Asa W. Whitney superintendent, H. F. Hannis treasurer. They will make chilled wheels, axles, boxes, etc.

Franklin Farrel, the millionaire president of the Bridgeport Forge Co., the Farrel Foundry and Machine Co., and owner of large sugar plantations in Cuba, paid off the entire debt of Christ church, Ansonia, just before the marriage of his daughter, Miss Florence Adele Farrel, to George Clarke Bryant this week. Rather than see his daughter wedded in a mortgage ridden church, Mr. Farrel summoned the trustees and, learning that $27,000 would make this church entirely free of incumbrance, drew a check for that sum and handed it to the astonished men. The church is one of the largest and handsomest in Connecticut, and the wedding was the most brilliant that ever took place in Ansonia. Besides the gift to the church, Mr. Farrel presented to the bride a dowry of $250,000 and handed the bridegroom $20,000 more to defray the expenses of a two months' wedding trip.

Personal.

President Goltra, of the American Steel Foundry Co., Granite City, Ill., has sailed for St. Petersburg, Russia, on a business trip.

James Allen, of Kalamazoo, Mich., will take charge of the Trusscott Manufacturing Co.'s brass foundry, which will soon start up at St. Joseph, Mich.

Henry T. Ganse has been elected president of the Harlem & Hollingsworth Company, Wilmington, Del., to succeed his father, the late John T. Ganse. Horace W. Ganse becomes vice-president, and J. Rodney Ganse a director of the company.

G. H. Carver, for a number of years superintendent of the Plano Manufacturing Co., Plano, Ill., is now vice president and superintendent of the Detroit Malleable Co., which occupies the plant recently vacated by the Michigan Malleable Iron Co.

Clement F. Street, for seven years past editor and manager of the Railway Review, Chicago, and during the four years immediately preceding, chief draughtsman for C. M. & St. Paul R. R. Co., at Milwaukee, has accepted a position with the Dayton Malleable Iron Company, Dayton, Ohio, to look after their railway business. This company has recently added 50 per cent to its capacity.

Thomas H. Williams and Samuel D. Tompkins, respectively, president and treasurer of the A. A. Griffing Iron Co., Jersey City, N. J., have been removed from office by a majority of the stockholders, Judge Collins, of the Supreme Court, sustaining the action. Williams and Tompkins claimed the right to hold office for one year by virtue of the by-laws. The court's decision is that officers of corporations have no fixed tenure of office.

Robert Pultney, Youngstown, Ohio, one of the defendants in a suit brought against the stockholders of the Pultney Foundry Co. by the Commercial Bank, failed to respond today when the case was called for trial, and inquiry showed he had left the city under a cloud. Some time ago the First National Bank discounted a note purporting to be signed by Edward Pultney and his father, William Pultney. When presented for pay-

ment President McCurdy said that William Pultney pronounced his signature a forgery. The son agreed to settle the matter, but failed to do so, and his present address is unknown.

Obituary.

Alexander Minmick, of Singer, Minmick & Co., died in Pittsburg December 20.

W. M. Wilson, vice-president of the American Steel Casting Co., Chester, Pa., died November 18.

Ezra G. Cone, the bell founder, of East Hampton, Conn., died of paralysis at his home in that city, Dec. 22, aged 67 years.

James Cassidy, senior member of the firm conducting the Enterprise Foundry, Aurora, Ill., died December 19th, of pneumonia, aged 70 years.

Fred Kelley, for nearly 30 years treasurer of the Lewiston Machine Co., Lewiston, Me. died December 26, at his home in that city, from apoplexy, following la grippe.

John H. Eagan, superintendent of the pattern department of the Edward P. Allis Co., of Milwaukee, Wis., died of pneumonia, Dec. 25, at his home in that city, aged 47 years.

Eben A. Baldwin, a member of the firm of Davis & Furber, North Andover, Mass., died December 21, 49 years old. He had been with the firm since his nineteenth year.

Robert Smack died at his home, Brooklyn, N. Y., Dec. 28, aged 74 years. He had been in the foundry business in New York city for 48 years, under the style of Robert Smack & Co.

Samuel S. Beat, founder of the Globe Iron Foundry, at New York city, and which was afterward located in Port Chester, N. Y., died at Rye, N. Y., December 31, aged 70 years.

John Fisher, senior member of the firm of Small & Fisher Co., limited, proprietors of a large machine shop and foundry at Woodstock, Canada, died December 11, after a brief illness.

J. B. Merrill, of the firm of Merrill & Cole, of the Beloit Iron Works, died Dec. 26, at Rockford, Ill., after a long illness from heart trouble. He was one of the foremost in building up the manufacturing industries of Beloit.

John Taylor Gause, president of the Harlan and Hollingsworth Co., Wilmington, Del., died in that city, December 1, aged 75 years. In 1843 he began with the company as errand boy, and 1883 he became president of the corporation.

John W. Chalfant, president of Isabella Furnace, and prominently identified with many important industries in Pennsylvania, died in his native city, Allegheny, Pa., aged 71 years. Mr. Chalfant was one of the founders of the Duquesne Club.

Leonard B. Tinkham, 85 years old, died at the home of his daughter, in Worcester, Mass., Dec. 28. He was foreman pattern maker for Rice, Barton & Co., five years ago, when a fall from a street car injured him so that he never recovered his health.

J. H. Strothman, a member of the Strothman Iron Co., of West Superior, Wis., died December 19 of heart disease, at his home in Central Park, Wis. He went to West Superior in 1887, and had always been a potent factor in the development of the city.

Henry A. Chapin, owner of some of the most famous iron mines in Michigan, died December 17 at his home in Niles, Mich., at the age of 86 years. He was very rich, his palace domicile cost $200,000. He had received above a million dollars in royalties on mineral lands that cost him but $250.

Stephen A. Morse, inventor of the twist drill, died in Philadelphia, December 22, seventy years old. He founded the elevator firm of Morse, Williams & Co., with which two of his sons are still connected. Mr. Morse had been afflicted with blindness, the sequel of la grippe, for seven or eight years past.

John Keesey, formerly a member of the firm of Wetherill, Keesey & Wildey, of Chester, Pa., died December 5, at his home in Wilmington, Del., aged 76 years. Mr. Keesey retired from the concern some years ago and the firm name was changed to Robert Wetherill & Co., and the business is still continued at Chester Pa.

Morris P. Janney, mechanical engineer with the Pottstown Iron Co., died after a lingering illness at his home in Pottstown, on November 30, 1898. In past years he had been highly connected with several iron manufactories, among which were the Glendon Iron Co. and the Janney & Wickersham Foundry and Machine Co.

William Furguson died at St. Mary's Hospital, Hoboken, Friday night, December

16. He ran a large foundry in that city a few years ago, and was at one time said to be worth $50,000; but he lost everything and died absolutely penniless, and was buried at the expense of James Campbell, his former partner. Mr. Ferguson was a molder by trade.

John Pettigrew, died at his home, 524 West Chicago avenue, Chicago, Ill., on the afternoon of Monday, Jan. 2. Mr. Pettigrew was 55 years old; he leaves a family. An excellent illustrated article by Mr. Pettigrew under the title "A Reservoir Substitute for Ladles," appeared in THE FOUNDRY for November last, and he had under contemplation the preparation of other articles for publication. Mr. Pettigrew was an able foundry foreman, and the fact that he was just beginning to impart his ripe experience through the press adds to the calamity of his death.

Mr. Henry H. Garrett, general foreman of the Westinghouse Machine Co.'s foundry, Pittsburg, Pa., died December 29. He was born in Vermont, 1840. He came to Pittsburg from Albany, N. Y., where he had been engaged in the foundry business. He took charge of the foundry department of the Westinghouse Machine Co. in 1882 and remained in that position for almost seventeen years. Mr. Garrett was an exceptionally able mechanic in the foundry line and his work was a source of admiration to all who visited the works of the Westinghouse companies. In addition to his mechanical abilities, he was a man of rare gifts and had a strongly artistic temperament and inclination. He was a man of the highest character and was beloved by all who came in contact with him. Indeed, it is rarely that a man of strong ability is able to so conduct himself as to win the admiration and respect of all classes, both those under his charge and those superior to him in authority, as Mr. Garrett succeeded in doing. He leaves a family consisting of his widow, two sons and two daughters. His remains were taken to Albany, N. Y., for interment.

Fires and Accidents.

December 27, Francis & Magrin's foundry, Chicago, was damaged $2,500 by fire.

December 18, the Eagle Stove Foundry, Fall River, Mass., was damaged $600 by fire.

December 19 fire did $900 damage to the foundry of William H. Braid, Brooklyn, N. Y.

December 14, the foundry of Arnold & Pierce, Worcester, Mass., was damaged $500 by fire.

December 9, the Western Foundry, at St. Louis, was damaged by fire; amount not stated.

December 11 Arthur Windell sustained a broken leg at Hurt & Buck's foundry, Brantford, Ont.

The Syracuse Malleable Iron Works (N. Y.) were damaged by five November 17; $10,000; insured.

December 13 the Union Iron Works, Sacramento, Cal., was damaged $60,000 by fire; $20,000 insurance.

December 12, fire damaged one building of the plant of the Missouri Car and Foundry Co., St. Louis; insured.

December 8, many valuable patterns were destroyed by fire and water in the pattern storehouse of the Lowell Machine shop.

Fire, November 26, caused $8,000 damage to the plant of the Stevens Manufacturing Co., London, Ont., iron and brass founders.

December 18 fire partly destroyed the works of the Merchants' Foundry and Machine Co., causing a loss of $2,500. Insured.

At Norfolk, Va., the Norfolk Foundry and the machine shop and foundry of W. A. Anderson were badly damaged by fire, December 8.

December 19 the foundry and machine shop of Caird & Hawkesworth, Helena, Mont., was destroyed by fire. Loss several thousand dollars.

December 14, fire did $60,000 damage to the foundry and machine shop of the John Woods Manufacturing Co., Norristown, Pa. Partly insured.

Fire in Caskey Bros.' foundry, Newport News, Va., Dec. 29, did $20,000 damage; $12,000 insurance. The foundry had been working day and night on government contracts. The fire originated at the smoke stacks. A larger and more complete foundry will be built at once, the frame work to be constructed of steel by the Berlin Iron Bridge Co.

December 21 George Boyd, aged 30, an employe of the Farrel Foundry and Machine

Co., Ansonia, Conn., died at his home, as the result of burns received while working inside of an upright boiler. The fire had been out for several hours, but in some mysterious manner the steam suddenly rushed in upon him, and, before he could be extricated, he inhaled some of it.

New Buildings and Enlargements.

J. L. Roberts will erect a foundy at Walla Walla, Wash.

J. Westwick & Son, Galena, Ill., will double the size of their foundry.

The Wittenberg-Higgins Co. has built a new foundry at Moline, Ill.

The E. W. Goss Co., of Springfield, O., will double the capacity of their foundry.

The Auburn foundry at Garrett, Ind., is being operated under new ownership.

The American Steel Barge Co., West Superior, Wis., will build a foundry 60x250 feet.

The United States Radiator Co., West Newton, Pa., is building an addition 55x105 feet.

The Shields Foundry Co., Foxboro, Mass., recently built an addition to foundry 17x38 feet.

The Chicago Hardware Foundry Co. is erecting two large buildings at North Chicago.

The new malleable iron plant at Albion, Mich., started up the second week in December.

The Memphis Car and Foundry, Memphis, Tenn., is to be reorganized, and will employ 750 hands.

J. R. Cook & Son, of Oglethorpe, Ga., will establish a machine shop and foundry at Americus, Ga.

The Houston & Texas Central Railroad Co. is enlarging its machine shop and foundry at Ennis, Tex.

A. C. Rex & Co. are preparing to build a large addition to their foundry at Frankford, Philadelphia, Pa.

An addition 75x240 feet is to be built by the Michigan-Peninsular Car Co., of Detroit, one story, of steel.

The Syracuse Malleable Iron Co., New York, is building an addtion 40x162 feet and another 30x70 feet.

Espey Bros. will establish a machine shop and foundry at Crookston, Minn., and will make a general line of iron machinery.

The Forest City Foundry and Manufacturing Co., of Cleveland, Ohio, will erect a building 133 by 90 feet, five stories high.

It is reported that the Lehigh Valley Railroad Co. will locate a wheel foundry at Weatherby, a short distance from Hazleton, Pa.

A permit has been issued to the Russell Wheel & Foundry Co., Detroit, Mich., to erect a one-tory steel manufactory 75x240 feet.

The Robinson Thrashing Machine Co., of Richmond, Ind., are said to have announced a 10 per cent increase in wages in all departments.

The Louisville & Nashville Railroad Co. will double the capacity of its shops at Decatur, Ala. Five hundred additional men will be employed.

The Structural Iron Co., of Baltimore, has contracted to erect a large iron foundry building for the Lobdell Car Wheel Co., of Wilmington, Del.

The Albion Malleable Iron Co., Albion, Mich., is about to move from its old to its new works. W. S. Kessler is president and H. B. Parker vice-president.

The Youngstown Foundry & Macine Co., Youngstown, O., has recently remodeled and enlarged its plant and installed a traveling crane of twenty tons capacity.

The Merrill Iron Works Co., Merrill, Wis., has finished new machine shops and foundry; also offices and other buildings, and has made other extensive improvements.

The Champion Manufacturing Co. has bought all the property of the Rocky Hill Foundry Co., Rocky Hill, Conn., and will start it in operation January 1, 1899.

A recently organized company, W. T. Baxter, manager, is operating the old stove foundry in the manufacture of general castings for plows and mining machinery.

The Liquid Pressed Casting Co. has been inaugurated at Chicago with a capital of $60,000, to make metal castings, by Frank G. Howser, Thomas B. McGregor and R. L. Terry.

The new Stevens Agricultural Machinery plant, moved to Marinette, Wis., from Auburn, N. Y., has started up in the foundry

department. They expect to employ 200 men.

The North Wales Foundry Co. have been granted limited partnership papers. The company consists of F. Sabin, H. Miller and P. Vanfleet; capital stock, $16,000.

The Union Iron Works Co., San Francisco, Cal., has secured license to use the Tropenas steel process and is now building a large foundry, to employ two 2-ton Tropenas converters.

A large addition to the works of the Crane Elevator Company is about to be built, the cost of land, buildings and equipments being estimated at $500,000. The new foundry will be 226x90 feet.

The Titusville Iron Co., Titusville, Pa., are increasing the capacity of their radiator works by the erection of a new structural iron machine shop 420x80 feet and foundry 180x80 feet. They operate a molding machine which has a capacity of four to five sections a minute.

The Moline Plow Co., Moline, Ill., has rented the Downing Foundry and will operate it in addition to their own foundry, in order to get out their work, which is piling up on them far beyond their capacity. In the early spring the company will build a large new foundry.

The Aultman & Taylor Machinery Co., Mansfield, Ohio, are enlarging their plant by a building 106x127 feet, thus giving two-thirds more foundry capacity. Some lines of this concern's business has more than trebled the past year, and they have had to buy castings outside largely. They expect now to be able to do all their own work.

The Youngstown Foundry and Machine Co., Youngstown, Ohio, manufacturers of light and heavy castings, have just finished extensive improvements. The foundry has been greatly enlarged and a 20-ton traveling crane added. After the year's run without loss of a day except the holidays, their increasing business compelled the enlargement.

The Robinson-Rea Manufacturing Co. and the Leechburg Foundry and Machine Co. have consolidated, and the name of the new concern is the Mesta Machine Co., George Mesta president, and W. H. Rea treasurer. They will manufacture steel, sand and chilled rolls, machinery for rolling mills, steels plants and tin plate mills, and machine molded steel gears and ingot molds.

The Malleable Iron Fittings Co., of Branford, Conn., have placed contracts for extensive additions to their plant. The old pattern vault is being torn down to make room for additions to the factory, 80x200 feet, two stories high, brick, with gravel roof. The second story will be constructed to carry 500 pounds to the square foot, and will contain new, heavy machinery for cutting steam, gas and water fittings. The new storage vault will be two stories high, 32x55 feet. The Branford Malleable Iron Fittings Co. was perhaps the first to use coke iron in the manufacture of malleables.

The Belle City Malleable Iron Co., Racine, Wis., expect to commence molding in one of the departments of their new foundry the first week in January. The new buildings replacing those recently destroyed by fire will add to the former capacity. The main foundry will be 486x70 feet, and the additional foundry 288x76 feet. A hot-air heating apparatus will be installed throughout the plant. New tumbling barrels, pattern room and other adjuncts will be provided, and all will be modern and up-to-date. The new foundries will have a floor space for 175 molders, and it is the aim of the company to adopt all modern appliances known to the malleable business.

CAST IRON NOTES.

Devoted to inquiries from Practical Foundrymen on the subject of Melting and using Cast Iron. Address all Inquiries to W. J. KEEP, care of The Foundry.

LOSS OF IRON IN MELTING.

Do you know of any exact or approximate ratio that the percentage of loss in melting and the percentage of coke should bear to the total amount of iron put into the cupola? And also how the percentage of loss in melting is affected by the mixing of malleable iron and gray iron scrap with pig iron? As an example: Assuming that the total amount of iron of all kinds introduced into a cupola with a capacity of 3 tons per heat is 150 tons and that the mixture is divided on the following percentages: No. 1 X crane, .353; No. 2 X crane, .596; C. C. Hinkle, .018; gray iron scrap, .013; malleable scrap, .020.

How many pounds of coke should be consumed and what percentage of loss in melting should occur in a first-class cupola?

ANSWER.—Much depends upon the dimensions of the cupola. The larger the diameter for a 3-ton melt the more coke would be required, but the more rapid the melt. A cupola small enough to give the greatest economy would deliver the iron so slowly that not more than four or five ladles could be taken out before stopping the tap hole, and a small cupola is more likely to clog with slag. For such a small heat I presume that one pound of coke would melt seven pounds of iron. The addition of gray or malleable scrap would not increase the loss in melting. It is a very difficult thing to estimate such loss. The weights of a melt are very unreliable. If they were accurate much dirt, sand and half-burned coke is weighed into the cupola as iron. If you purchase 150 gross tons of pig iron and weigh net tons you will get more than 150 tons of castings, for there is nothing like 10 per cent of sand and slag in good pig iron. If you weigh net tons into the cupola the scrap and sprues contain more or less sand and the pig iron is covered with sand. The castings from the cupola are weighed with some sand in the scale and some iron is lost from spilling from the ladles. Loss, therefore, is mostly a mistake of weights. There is no use figuring at all from melter's weights because in the hurry of charging the weights are generally heavy. At present I have taken the weighing out of the hands of the melter and it is accurately done but I charge sprues with sand on. I found that I could mill off 5 pounds of sand to 100 pounds of sprues, so I set the scale beam to allow for that much of sand. The screenings from gangways contain much dirt and the iron from the cinder mill contains considerable slag and unburned coke. To make an allowance for this would be guesswork. Pig iron contains more or less cinder or some sand on the surface of the pigs and this is all weighed into the cupola as iron. Even if it was determined how much of foreign matter was called iron in a single charge and the scales set to allow for it, such allowance could not be correct for all charges. Where the weights on the scale beams are out of reach of the weigher and he does his work accurately I am inclined to think that a good way is to allow for the sand on the sprues and then charge the iron from cinder mill and sweepings without weighing them. It will average about 50 pounds to the ton of iron melted. Charging in this way for the past two months there is a 2 per cent loss in our melting. It is not possible to get at the loss due to remelting iron, if there is a any, for the reasons given.

USING COLD SHORT IRONS TO PREVENT SHRINKAGE CRACKS IN CHILLED SURFACES.

"Referring to R. D. Moore's article in the November FOUNDRY and to his recommendation to use weak cold short iron to offset shrinkage cracks caused by the excessive use of strong hot irons, do you not think that good results could be obtained without resort to weak cold short iron? By mixing irons that each have a definite weakness a strong mixture can be obtained. It has been my experience that a redshort iron can be overcome by taking out a portion of it and putting in its place another iron of redshort tendency but of a definite physical structure, thereby giving a sound casting when it became cold, which would show great strength. For the ordinary run of work Mr. Moore's plan is very satisfactory and is easy to follow, but would it always be advisable to use a cold short iron, especially if one is aiming to procure an extra strong casting?"

ANSWER.—The above refers to chilled iron castings which cracked by the rapid cooling of the chilled portion and the one who asks the question adds: "I think the casting that cracked could have been made equally as strong and without cracking by either using the same mixture and adopting a slower method of cooling, or using another strong iron of a proper nature in place of a portion of the iron which was causing the trouble." The questioner's opinions are perfectly correct but he seems to have lost sight of two facts.

First, the terms cold short and hot short do not properly apply to cast iron; and, second, strength is very largely a question of grain and not of chemical composition, and the property of taking chill does not accompany any definite chemical composition. The writer evidently calls a casting which cracks before it is cold hot short iron, and a casting cold short that is weak when cold. The cracks in a red hot casting are caused by excessive or uneven shrinkage and the same casting with less shrinkage would not crack. But if the iron has small shrinkage it may not take as deep a chill. If a casting like a

car wheel is of a chilling iron and the circumferance is made to shrink suddenly upon an already solid center which is swelling or at least not shrinking as rapidly, the rim is very apt to have surface or chill cracks. If the shrinkage can be diminished without lessening the depth of chill the cracks may be avoided. From a chemist's standpoint a pig iron increases in cold shortness as its silicon increases. A silvery iron with from 5 to 8 per cent of silicon is excessively cold short and such iron is generally very weak. The weakness is caused by the peculiar grain and such irons are not strong when hot. They are weak all the time and cold shortness is not a proper designation. The terms hot and cold short apply to wrought iron. Some is brittle when cold but can be forged when at any degree of red heat. Other iron is tough when cold but if struck when at a peculiar dull red heat it will break off short. A neutral wrought iron is strong when cold and can be forged at all red temperatures. The furance men call pig iron which when puddled and made into wrought iron will make a cold short iron by the name of cold short pig and some pig iron would make hot short wrought iron. This same pig iron would not necessarily make castings having the same peculiarities.

It is a fact known that highly silicious pig would make a cold short wrought iron and that such pig iron is generally weak and will make weak large castings and it is quite natural that the furnace term of cold short has been used for castings. An iron needs a certain quantity of silicon to make a casting of a certain size strongest. A much smaller casting from the same iron will be brittle and weak and hard, but not from coldshortness, but because the smaller casting cooled faster and needed more silicon to be strong. A much larger casting from the same iron would be weak from too open a grain and would be very soft from excessive slow cooling, but would not be cold short. Each composition of iron will give the greatest strength only in one size of casting. An increase of silicon in the small casting will remove brittleness and thus will increase strength, that is, will be stronger than either of the original irons. The brittle small casting will have an excessive shrinkage and may crack, especially if a chill suddenly cools a portion of it, and an increase of silicon will diminish shrinkage and lessen the chance of cracks. In this case the union of an iron which would make a brittle weak casting of a small size, with an iron weak from excessive silicon will make a strong small casting. Some pig iron will make strong castings irrespective of its chemical composition. If another such strong iron can be found which contains more silicon than the former the union will probably make a very strong casting and will prevent the evil effect of excessive shrinkage.

Generally, but not always, stronger castings are made from a mixture than from a single brand of pig iron, and the nearer each iron comes to making the acceptable casting by itself the better will be the casting made from the mixture. Touching up the quality by the use of a small quantity of high silicon iron is very convenient and very generally satisfactory.

The chilling quality is inherent in the pig iron and not wholly dependent upon the chemical composition and therefore the full depth of chill may be maintained with a slight increase of silicon.

The general tendency of an increase of silicon is, however, to decrease chill and to lessen shrinkage.

By heating the chill the rate of cooling of the chilled portion would be retarded and the shrinkage lessened without necessarily diminishing the depth of chill.

Core Makers and Their Environments.

Core making is a branch of the foundry business too often looked upon as simple, unmechanical, accessory to the production of castings. It would seem that the core maker, of all the employes, is the least appreciated. As a rule, his immediate surroundings, bench, tools, drying plates, shelves for core boxes and for storage of cores—are of the crudest and most temporary character. There is usually uncertain and insufficient draft for his oven fire, and if provision is made for regulating the draft it is very liable to be unreachable and ungetatable. To put cores into or take them out of the oven, after drying, requires courage equal to that of a Rough Rider at San Juan Hill. It means, if the oven is hot, singeing of the face, hands and hair to a painful degree. If not a quick oven, as the cook books say, it means disappointment, wilting of energies and too often a growl and the laying of the cornerstones of feuds; oftimes to a scrap there and then with some anxious molder who has a hurry up job or a late cast, or maybe the taking out of a core

before it is sufficiently dried, resulting in the loss of the casting. And if lost, who's to blame? "Why that chump of a core-maker," and so on, ad infinitum. The result of all this is that a self-respecting man with any mechanical ability will chafe and get away from the core bench and core making as soon as possible. Not because the avocation of making cores is unpleasant of itself, but that the endless nagging and the jarring of his nerves from every side, and the lack of proper fittings and furnishings, render his best honest efforts futile. If success is the happy result of an intricate and difficult casting never a golden ray of glory scintillates as far as the core maker. The molder may get a faint ray; if so, he absorbs it all.

As a consequence of this state of affairs, with rare exceptions, the core making is done by men of soured and combative dispositions, who have developed a "don't-care-a-damn" condition of mind, and are frequently an irritating thorn in the side of the foreman.

Here are a few flowers that could be thrown in the path of these seemingly lightly appreciated toilers:

Plates for Drying Cores.—How few foundries, even those with a machine shop as a part of the plant, have true and straight core plates! How much time has been, is now, and ever will be wasted in putting on molding sand (also wasted) to get a crooked plate to bear, or come near bearing, on the flat joint of a core box, and when every care is taken, the core, when dry, not as true as a straight plate would leave it! How little the cost to have a cut planed off the surface of each core plate, just enough to straighten it! It is a good investment, in economizing sand, molding and core, also time, in not having to rub cores together to get a joint. Cores will be more uniform and true to size. Be sure that the core oven has a good draft with large firepot. Have dampers handy within reach outside, not inside the oven. Have the racks or shelves inside of the oven straight and stiff, with bars that will carry their load without sagging. If bars across the oven are used, have them rest in notches, so that when fairly heavy plates with cores are put in the oven the bars will not be pushed out of their proper position, letting plate and core, and incidentally the core maker's soul, go down, down to destruction. Have the fire where it can be replenished easily, the grate where it can be cleaned and raked without a backache or heartache. Have for small cores an upright spindle with revolving shelves. Have the door in two or three parts, so that a portion of the opening can be used when a portion only is wanted, and the whole can be opened if necessary. Then the oven will not be depleted of all its heat each time you open the door. It will save fuel and add to the comfort of all in the vicinity of the oven. Have a deep ash pit with unobstructed air passage to the grate. The grate can be close between the bars, and, with plenty of area, cinders can be used and produce all the heat required for average small cores, at least. Have a roomy bench, good and solid, with roomy bins for core rods and wires, and with drawers for tools, brushes, vent strings, etc.

These, and many more, are provisions for the making of cores that will make an oasis in the core maker's present desert. The securing of them will enhance his self-respect; he will work more days in the year; turn out a better product and more of it, and there is not a thing in the particulars enumerated but that is in the true way of economy in time and material.—L. C. Jewett in "American Machinist."

Effect of Sand in the Cupola.

I have to confess that my views have undergone a decided change, within the past year, with regard to the effect of sand on the iron that is to be melted in the cupola. The natural supposition is that the coating of sand on the gates, and the rejected castings, and also on the pig iron, would retard the melting. Many years ago I read and studied very closely Dr. Kirk's book on founding, and, if I mistake not, he says that the pig will melt most readily at the fractured end, because of the total absence there of the sand coat. From this I inferred, as a matter of course, that the sand coating was a positive detriment as protecting the iron from the heat. A good deal has been written in support of this theory. Latterly some of the blast furnaces have taken to using iron molds instead of sand pig-beds, and I, as well as a great many others, expected that this would increase the speed, as well as reduce the cost of melting.

Until a little more than a year ago it had always been my practice to tumble the shop

scrap so that it should go into the cupola perfectly clean. I am now of the opinion, however, that this, instead of being a measure of economy, was, on the contrary, an element of cost. The practice that led up to this conclusion was purely accidental, and would not have been followed but from sheer necessity. We simply had not sufficient tumbling-mill capacity to enable us to clean the shop scrap, and so it went into the cupola with the sand on it.

To my surprise the melting seemed not to be retarded an iota, nor did there appear to be any other detrimental effect. On the contrary, I am convinced that the sand coating acted as a flux, and so obviated the necessity for the use of limestone. It may be that the melting of a limited amount of iron could be expedited by absence of sand, but I think that in the absence of sand or other flux the charge would soon become clogged with solidified ash, cinder, etc., and that the whole effect would be to retard the melting to a considerable extent. During all this time I found it entirely unnecessary to use any sort of flux, other than the sand that clung to the iron.

A few years ago a couple of men went through the country introducing, for a consideration, a method of improvement in melting practice. When they ran up against Mr. Keep, of Detroit, Mich., he found that their plan was to introduce sand into the charges. He told them that he was already doing that very thing. They wished to know how he "got onto" the practice and how he did it, and he answered that he used the shop scrap and the pig iron without cleaning, and that there was abundantly enough sand for the needed flux without adding any more.

It may be that some kinds of sand are better than others for this purpose, but the practice is followed in widely separate parts of the country with perfect success; which would seem to indicate that almost any ordinary molding sand that clings to the casting will operate as a good flux, and, in view of my own experience, I do not hesitate to advise foundrymen to try the plan.—Chattanooga Tradesman.

The Garden City Sand Co.

The Garden City Sand Co., of Chicago, is getting some letters from blast furnace managers concerning the Franklin Crown and Sligo fire brick that are calculated to make them feel pretty comfortable over the fact that they are sole agents for these brick in the northwest. Furnace No. 1, at Ensley, Ala., went in blast with complete lining, inwall, crucible and bosh, of the above brick, on June 28, 1894, and remained in continuous operation until June 30, 1898, making 253,533 tons pig iron; the greatest record ever made in the south.

The Sheffield Coal, Iron & Steel Co., Sheffield, Ala., lined with Franklin Crown and Sligo brick, and after an eight months' run without burning a single tuyere, ordered brick for complete lining for their No. 3 furnace.

The Tradesman Annual No. XX., being the January number of The Tradesman, published at Chattanooga, Tenn., is a specimen of trade journalism that it would be hard to beat. It is a book, about 8x11, containing 248 pages, in which may be found a history of the industrial progress of the whole south, comprehensive in scope, and authoritative in character. It is a very mine of information concerning this rapidly developing part of our country, partly in the form of special articles written by men at the head of the various branches of industry treated upon. A directory of the leading industrial firms fills about 75 columns. The South may well be proud of this great trade journal.

Come Again.

Ernest Marceau, foundry superintendent with the Adams Company, of Dubuque, Ia., paid the associate editor a visit a few days ago. We were shopmates in the long ago, and had not met for fifteen years. Ernest is all right. He occupies a good position with a good company, and is just now on a trip, selling Farwell molding machines by the carload. Come again, Ernest; but don't wait fifteen years.

What They Say.

Blaydon-on-Tyne, England.

Please advise when our subscription expires. We want to renew for another year. We find THE FOUNDRY extremely valuable and interesting, and do not want to be without a single number.

SIMPSON IRON CO.,
Columbus, Ohio.

THE FOUNDRY is a splendid investment. I would not be without it for double the money it costs.

C. L. GILBERT, Charlottville, Va.

Catalogues Received.

A second illustrated edition of the lecture on Mechanical Draught for Steam Boilers, delivered at Cornell University by Walter B. Snow, of the engineering staff of the B. F. Sturtevant Co., Boston, Mass., has just been issued to meet the demand for information on this important subject. Copies may be obtained on application of the Sturtevant Co.

We have received the B. F. Sturtevant bulletin F, describing the electric motors and generators manufactured by the firm. These machines are made in the highest style of the art, and have many special features of excellence. Both multi-polar and bi-polar patterns are illustrated. Tables are given of rated horse-powers, revolutions per minute, dimensions of pulleys, weights and prices of machines.

The S. Obermayer Company announce that they are prepared to supply wax tapers (which are used as an improved method of venting cores) where complicated connections have to be made, to allow free flow of gas from core. They are of any length and thickness, on order, but they have in stock 1-4" diam. by 18" long, in 25 and 50 lb. cases. The taper is simply rammed up in the core and left there, thus greatly facilitating the venting of cores of difficult shape.

Bulletin G, November, 1898, is just arrived from the B. F. Sturtevant Company, Boston, Mass. It is an 8x10 inch pamphlet of eight pages, illustrating and describing as many sets of generators and engines. The engines are all automatic, and the generators are of improved design, specially constructed as to self-cleaning features. Both horizontal and upright engines are employed, and the sets are strongly and compactly constructed on solid cast iron beds. A table accompanies each illustration, giving size of engine, steam pressure required, Watts, number of 16 c. p. lights and weights.

The sets illustrated are standard, and can be made either right or left hand. Special combinations will be made to meet any requirements. Prices will be furnished upon application.

The estimation in which the Buffalo Blowers are held is attested by letters from many who have had them in use for many years past. These letters come from firms such as "The Tredigar Iron Works," Richmond, Va.; Gaar, Scott & Co., Richmond, Ind.; Louisville, New Albany & Chicago R. R. Co., Lafayette, Ind.; Brooks Locomotive Works, Dunkirk, N. Y.; Terre Haute Car & Mfg. Co,. Terre Haute, Ind.; Buffalo Cast Iron Pipe Co., Buffalo, N. Y.; etc., etc.

These letters all speak one and the same sentiment, viz., that the blowers give entire satisfaction under all conditions of use. In this connection, we have received from the Buffalo Forge Co. a book of some 140 pages, 7x9 inches, illustrating American Schools of Mechanical Technology, giving both exterior and interior views of many institutions, that have in use the blowers for forges and cupolas. There are views of more than 50 schools, besides numerous large factories, and the company states that not one-fourth of the schools actually using the blowers are here represented.

The Tabor Mfg. Co.'s catalogue, standard size, illustrates the molding machines made by the company. THE FOUNDRY recently contained an extended notice of these machines, accompanied by illustrations, which our readers will remember. These are the vibrating machines, operated by compressed air. In addition to their regular line of machines they make special ones to fit anybody's flasks. They make also what is called a "hand vibrator machine," for work covering large areas, to ram which by power would demand enormous pressure and very expensive machines. These are of light construction and portable, if desired, with hose connection to the pneumatic vibrator, at greatly reduced cost. In these machines the patterns, of wood if necessary, are mounted on plates exactly as in the power machines, and are drawn from the sand under the influence of the vibrator in just the same way, except that where the work is large they employ power for drawing the patterns instead of the hand lever. These machines are special.

Fire Proof.

"Locomotive Engineering" was burned out Dec. 5th, and the January number comes out ahead of time in a new dress, painted red, covering above 40 pages in excess of the last previous issue!

We warrant that "Locomotive Engineering" will have no difficulty in replacing its burned subscription list; another fire, and the whole country would want to be "in it!"

NOTICE!

Advertisements in this column, 30 cents a line for each insertion About seven words make a line. The Cash and Copy should be sent to reach us not later than the 20th to insure publication.
Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our **subscription** list, we will give one free insertion under this heading to those in want of positions, the advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

WANTED—To correspond with a party capable of taking charge of a foundry making furnaces and boilers. Address E, Box 186, care of THE FOUNDRY.

WANTED—Up-to-date foundryman desires situation as foreman of foundry making light and heavy machinery castings. Address FOREMAN, Box 201, Care THE FOUNDRY.

WANTED—Position by practical foundry foreman; well posted in mill, mining, pumping and general machinery; also in mixing and melting of irons. Good references. Address Box 198, care THE FOUNDRY.

WANTED—Foundry foreman for shop making from 5 to 8 tons of agricultural and general castings. Want a sober and competent man. Address, with references, KENTUCKY, Box 203, Care THE FOUNDRY.

WANTED—Position as foreman by practical foundry foreman, well posted in mill, mining, pumping and general machinery; also in mixing and melting iron. Good references. Address Box 198, Care THE FOUNDRY.

WANTED—Position as foundry foreman by young man of good habits, first-class mechanic; can handle men to advantage; light and heavy, green and dry sand molding. Best references. Address, Box 204, Care THE FOUNDRY.

WANTED—Partner; live business man with $5,000 to invest in the foundry and machine business. A rare opportunity for a good heating engineer or practical foundryman. Address H. and H., Box 202, Care THE FOUNDRY.

WANTED—Position as foreman of foundry making castings in loam, dry and green sand; can manage men to advantage, and experienced in cupola practice; temperate. The East preferred. Good references. Address Box 206, Care THE FOUNDRY.

WANTED—Position as foreman of foundry; 45 years old, 25 years' experience in handling men, making all kinds castings, loam, dry and green sand; expert in mixing irons; make sand and chilled rolls. References, present employer. Address Box 205, Care THE FOUNDRY.

WANTED—A first-class patternmaker, having experience in the construction of harvesting machinery and other agricultural implements, by firm in Ontario. State number of years' experience and in what shops. A steady situation to right man. Address Box 207, care THE FOUNDRY.

WANTED—Position as foreman by industrious, sober young man, first-class mechanic (15 years' experinece) thoroughly acquainted with modern foundry practice, in making of heavy and light castings, capable of handling men to advantage. Best references. Address Box 200, Care THE FOUNDRY.

WANTED.—Position as superintendent or foreman of foundry. Have had 25 years experience in handling men, making all classes of loam, dry and green sand castings; air furnace expert; mixture for rolls, hydraulic machinery and ammonia fittings a specialty. References. Address, Box 180, care THE FOUNDRY.

WANTED—By a metallurgist, eminently successful in thorough laboratory work and in its practical application in foundry practice, permanent position. Chilled, soft and specialty castings to specifications with economy. Laboratory for sale to employers. Can influence orders for paying special work. Address Box 163, care THE FOUNDRY.

FOR SALE—Foundry and machine shop, with good equipment of tools; established seven years; in western mining and agricultural town of 7,000. Population increased 3,000 in three years. Price, with buildings and grounds, $7,000; $3,000 cash. Profits fully $3,000 per year. Ill-health cause of selling. Address "Oregon," Box 208, care THE FOUNDRY.

FOR SALE—One 72-in. cupola with stack; No. 9 Buffalo blower; 56-in. Boston blower; No. 6 Sturtevant fan and No. 4 Roots blower; one 4-ton foundry ladle; one 10-ton and two 2-ton hand jib cranes.
WE MANUFACTURE GRINDING AND MIXING PANS FOR PIPE FOUNDRIES, FOR GRINDING BRASS ASHES, ETC. THOMAS CARLIN'S SONS, ALLEGHENY, PENN.

WANTED—A practical foreman for foundry. Must understand mixing irons and be familiar with molding large pulleys; also molding pulleys, gearing and hangers on molding machines and general machine castings. Applicant must thoroughly understand handling of men and be systematic. Highest references required. Address, stating experience, age and salary expected. L. G. A., Box 209, care THE FOUNDRY.